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This Issue Contains

COVER—Loading 16-Ton Bulldozer for Air-Borne Engineers (*see article page 72*)

SEVENTEEN-POINT STUDY OF COLUMBIA RIVER DEVELOPMENT UNDERTAKEN 61
Ralph A. Tudor

THE ENGINEERS WILL COME THROUGH 65
Brehon B. Somervell

A RATIONAL APPROACH TO STREAM POLLUTION STUDIES 69
F. W. Kittrell

AIRFIELDS CONSTRUCTED IN THE FAR EAST. II. Air-Borne Engineers Provide Fields in Northern Burma 72
Stuart C. Godfrey

BASIC MAGNESIUM—THE DESERT GIANT. II. Contractor's Problems and Organization 75
Sherman Mason

RESOURCES OF WATER AND POWER AWAIT DEVELOPMENT IN PUERTO RICO 79
Donald F. Griffin

SEDIMENT COMPLICATES FLOOD CONTROL 83
Carl B. Brown

ENGINEERS ODYSSEY TO EUROPE—1889. II. England and Wales in Springtime 87
A. Prescott Folwell, James B. French, Andrew J. Provost, Jr., and T. Kennard Thomson

NEED FOR BROAD TRAINING INDICATED BY UNIVERSITY OF NEBRASKA QUESTIONNAIRE 90
Roy M. Green

ENGINEERS' NOTEBOOK
Observations Reveal Deformation of Steel Reinforcement . . 92
S. Sergev
Column Stresses in Portals, with Knee-Braces 93
F. Morgenroth

OUR READERS SAY 94
SOCIETY AFFAIRS 97
ITEMS OF INTEREST 111
NEWS OF ENGINEERS 114
DECEASED 114
CHANGES IN MEMBERSHIP GRADES 16
APPLICATIONS FOR ADMISSION AND TRANSFER 20
ENGINEERING SOCIETIES' PERSONNEL SERVICE 24
RECENT BOOKS 24
CURRENT PERIODICAL LITERATURE 26, 28, 30, 32
EQUIPMENT, MATERIALS AND METHODS 34, 36, 38
INDEX TO ADVERTISERS 42

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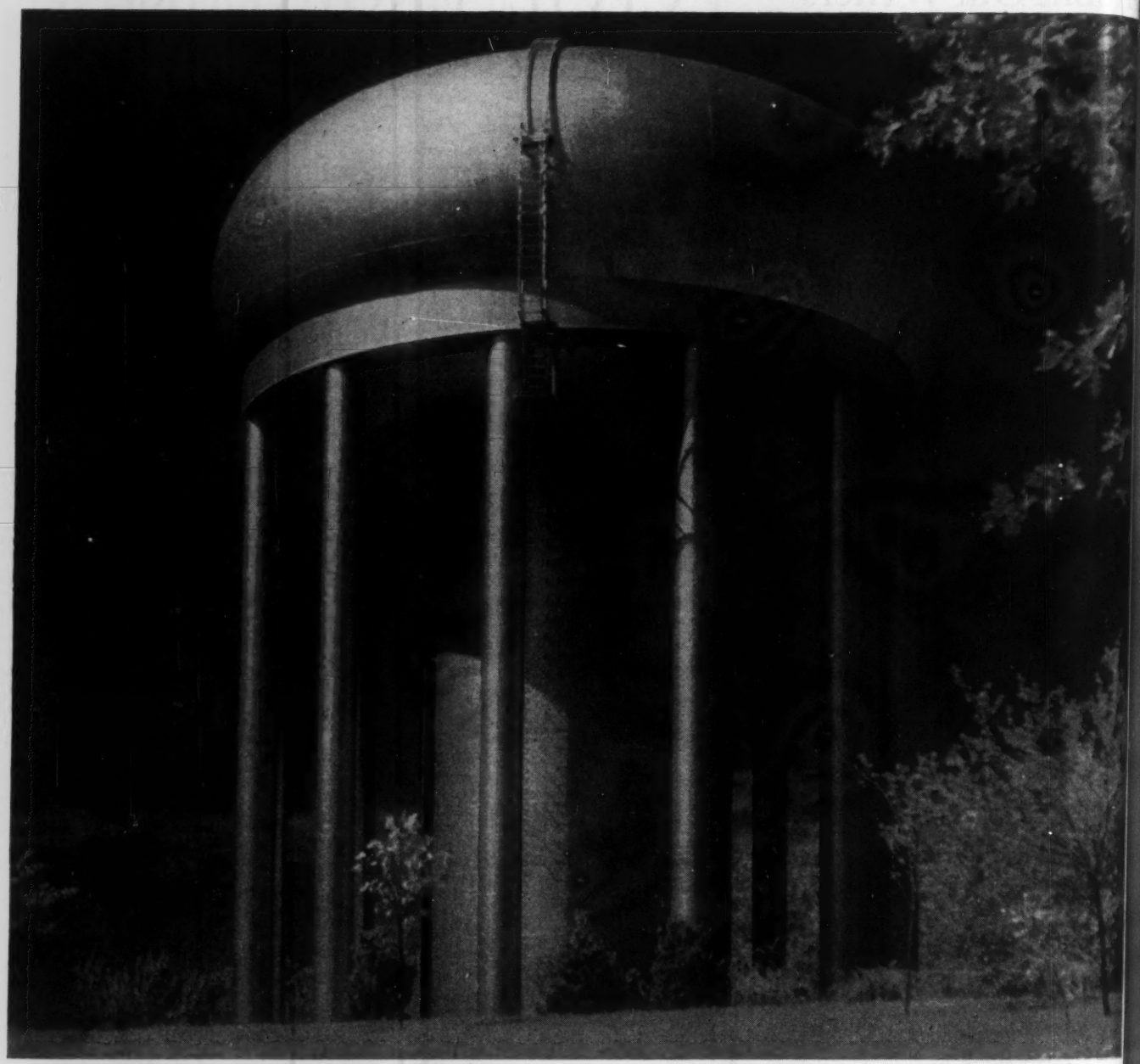

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Seventeen-Point Study of Columbia River Development Undertaken

By Ralph A. Tudor, Assoc. M. Am. Soc. C.E.
Colonel, Corps of Engineers, Portland District Engineer, Portland, Ore.

AN engineers' plan to take care of navigation, irrigation, flood control, power and related benefits is the objective of the investigation of the Columbia River System by the Corps of Engineers. Potentially the greatest river system of the United States, the Columbia offers at least 25 million kw of cheap power yet to be developed. That such development is to be orderly and well planned, the Senate specified when it authorized this study. Several U.S. Government agencies are cooperating with the Corps of Engineers, and Canada has agreed to join in the study and investigate waters north of the boundary. Because of the multiplicity of data to be collected, Colonel Tudor states, the report will not be completed until 1948.

THE Columbia River was one of the great attractions that drew explorers and settlers to the Pacific Northwest, and for more than a century it has served them, and their children after them, well. Although it remains relatively undeveloped today, it is known to be one of the most valuable natural resources of the North American continent. It possesses latent ability to irrigate several million acres of otherwise desert land, to support a system of inland waterways for navigation, to generate vast quantities of cheap power, and otherwise to benefit the extensive frontier of the Pacific Northwest. Some development has already been realized, but the potentialities have only been touched. In fact the full possibilities can only be estimated at this time.

Many studies and reports have been made and the most comprehensive are the "308" reports of the Corps of Engineers. These cover the main stem of the Columbia River below the Canadian border and portions of several of the principal United States tributaries. There remain, however, virtually the entire Canadian portion of the river system and many tributary sections in the United States which have not been studied in coordination with the rest of the system. With the relatively meager actual development that has so far been accomplished, no harm has come and no loss has been suffered, but with the more intense activity projected for the future, it is essential that the existing reports be extended and revised. Only thus will it be possible to obtain the greatest value for this water system at the least cost and at the earliest time compatible with proper development.

The need for such additional planning has been apparent for some time and has been the subject of much thought and discussion. The first positive action to this end was taken on September 24, 1943, when the Senate Commerce Committee adopted a resolution that directed the Corps of Engineers, U.S. Army, to proceed forthwith to extend and revise the "308" reports and to prepare a plan for the development and use of the water resources of the Columbia River system. The second important step was accomplished when, by an exchange of notes between the Canadian and the United States governments, the international aspects of the problem were referred to the International Joint Commission on March 3, 1944. In this manner, one of the most important and intensely interesting engineering investigations yet undertaken in this country has been started, and after approximately one year, it is well under way.

The importance of the study and the magnitude of the work involved can be comprehended only from a brief description of the Columbia River system. (See Fig. 1.) It is one of the great river systems of the world, exceeded in this country only by the Mississippi. In fact, the Columbia surpasses the Mississippi in so far as potential power development and irrigation are concerned. The principal tributaries are the Kootenai,

Fig. 1. Watershed of the Columbia River

VIEW OF WILLAMETTE VALLEY DURING 1943 FLOOD INDICATES NEED FOR PREVENTIVE MEASURES

Clark Fork, Okanogan, Wenatchee, Spokane, Yakima, Snake, Deschutes, Klickitat, Willamette, Lewis, and Cowlitz. The drainage area includes some 259,000 sq miles, of which 39,000 are in Canada. In the United States, waters from Wyoming, Montana, Idaho, Nevada, Washington, and Oregon flow to the sea by this route.

Most of the tributaries have their origin in the high Rockies and tumble through several thousand feet, the largest part of this fall being concentrated in the headwaters. Sufficient fall, however, remains below Spokane, Wash. (El. 1,870), Lewiston, Idaho (El. 738), Pasco, Wash. (El. 358), and other downstream points to permit the development of large blocks of power and to create significant navigation problems.

Rainfall and runoff characteristics of the area are unusual. Storms moving in from the Pacific ocean, principally from November to April inclusive, are forced to drop most of their moisture when they cross the Coast and Cascade ranges. West of The Dalles, the annual rainfall varies from 30 to 100 in. Between the Cascades and the Rockies is a vast semi-arid plateau with a rainfall generally of less than 14 in. Finally, the Rockies gather in from 15 to 50 in. of precipitation per year.

That this last is almost wholly snow and melts in the summer is attested by the fact that the City of Portland has two high-water periods each year. In midwinter, the Willamette reaches its high stage, while in midsummer, peak flow in the Columbia backs water up the Willamette to produce a higher stage at Portland. The maximum flow of the Columbia near its mouth reaches about 1,250,000 cu ft per sec, while the minimum uncontrolled flow is 55,000 cu ft per sec. Each year, an average of 189,000,000 acre-ft flows to the Pacific via the Columbia.

The region drained by this vast river system is rich in resources. In a few areas some of these gifts of Nature are developed quite extensively, but on the whole the potentialities remain for the future. The reclamation of irrigable land has advanced perhaps the fastest, and today, out of some 16,000,000 acres under cultivation in the United States portion of the basin, approximately 4,120,000 acres are irrigated. From surveys at hand, it appears that at least another 4,000,000 could be successfully irrigated. The value of this potential acreage to the nation is illustrated by a typical development of the Bureau of Reclamation in southern Idaho, where land once desert yields crops valued at $75 an acre.

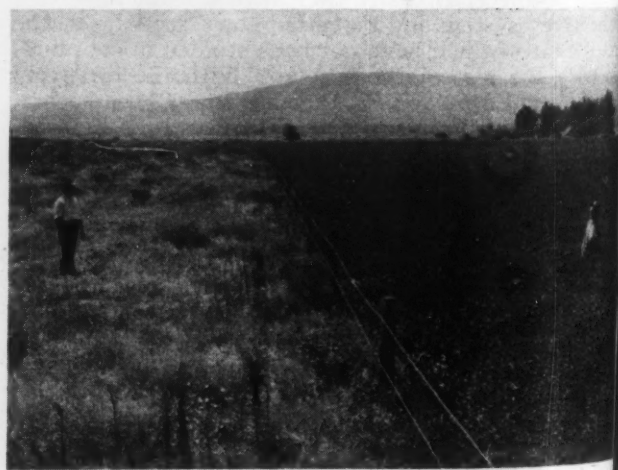
Deep-water navigation is provided from the Pacific Ocean to Portland and Vancouver (35 ft), and is authorized, but not yet dredged, to The Dalles (27 ft). Barge can be moved to Albany on the Willamette and to Pasco on the Columbia; and in recent years traffic on these waterways has been increasing rapidly. However, even in these up-river stretches serious obstacles to economic operation remain. In the Columbia there are several sections of fast rapids, and except at Bonneville Dam all locks are antiquated. In addition to vast improvement of the channels now available, future navigation will undoubtedly require new extensions up the Snake to Lewiston, further up the Columbia at least to Priest Rapids, to Corvallis on the Willamette, and possibly elsewhere.

The development of industry and of agriculture in the basin has already created the need for extensive flood protection in many areas. Some areas have already been made free from hazard. A great many more have been or are being investigated, and the comprehensive study will doubtless disclose others.

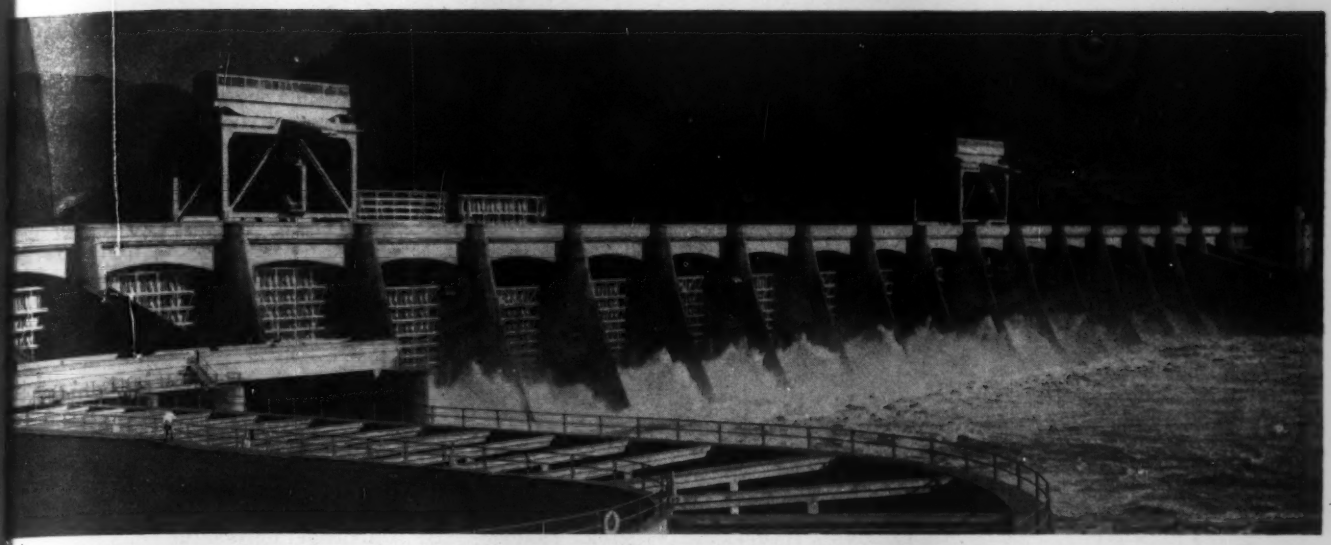
Development of hydroelectric power is still in its infancy, and future possibilities have not been determined. In fact, a great amount of investigation and planning is yet to be done in this field. An inventory of power plants shows that 67 of more than 500 kw are now operating, with a total generating capacity of 2,022,600 kw. Except for Bonneville and Grand Coulee dams, built and operated by the Army Engineers and the Bureau of Reclamation, respectively, the existing plants are not large, having an average capacity of only 10,860 kw. At the present time, it is not possible to do more than estimate the amount of power that the Columbia River system can economically generate. However, it is believed that at least 25,000,000 kw of cheap power is to be had as the need is created. By comparison, all the hydroelectric power now generated in the United States, including the great plants at Boulder, Shasta, Bonneville, Grand Coulee, and in the TVA system, totals approximately 25,000,000 kw.

METHOD OF STUDY

An investigation of the Columbia River system is so large in scope that it requires very careful and thoughtful planning, as well as the cooperation and advice of all interested parties. While it must be pursued vigorously and diligently, it should not be carelessly rushed to furnish a premature report. Preliminary discussions have shown that the study must be progressive in nature and that it must move successively from one problem to another. This will be more clearly understood from a



EXEMPLIFYING RESULT OF IRRIGATION (RIGHT SIDE OF FENCE) ON FERTILE BUT ARID AREAS OF THE NORTHWEST



ONE OF THE FEW COMPLETED PROJECTS ON THE COLUMBIA—BONNEVILLE DAM, WITH FISH LADDER IN FOREGROUND

statement of the various problems into which the study has been divided.

Furthermore, it was recognized that if the comprehensive plan is to meet with ultimate success, it must be generally acceptable to the several states involved. This is a difficult assignment, as the rights of the individual states are a matter of real concern to them. They are properly fearful of any general statements, but they have repeatedly concurred in the belief that a sound engineering plan can be worked out that will be mutually beneficial, without depriving any of them of their individual rights.

It is evident that nothing less than a good and complete job must be done in full cooperation with the states. For all these reasons, it was determined that five years should be devoted to the work, and a completion date of July 1, 1948, was established. In the meantime, development of the area will not be delayed, since enough projects have already been reported on and are ready for prosecution, if Congress desires, to bridge the gap.

SEVENTEEN SEPARATE PROBLEMS

In planning the study, it seemed best to divide the work into a number of separate problems. Each of these is to be the subject of a partial report, and all are later to be combined into a single comprehensive report. Many of the problems cannot be started until others are at least partially completed, and this is provided for by proper scheduling. A brief résumé of each of the problems follows.

Problem 1. Inventory of Projects and Investigations. Much development, already accomplished or planned in the area, has been inventoried in detail. The inventory includes both public and private projects for irrigation, flood control, power generation, navigation, and other purposes in the United States. This was completed on July 1, 1944.

Problem 2. Stream Flow, Hydrological and Meteorological Data. A great volume of stream flow, flood, storm, snow survey, and meteorological records has been accumulated, and an inventory of these was completed on September 1, 1944. A study of these records indicates the need for additional data, and those that can be accumulated during the preparation of the report are being obtained.

Problem 3. Mapping. Many areas have been mapped by various agencies, and a complete inventory of this work has been made. It has now been determined that rather extensive additional areas must be surveyed and mapped to permit a proper engineering study of the area. It is intended to map only the necessary streams, not the entire basin. During the past summer, aerial photographs were completed. Ground control and maps will be expedited, but the task is so great that it is not expected to be completed until January 1, 1948.

Problem 4. Natural Resources. Innumerable surveys have heretofore been made of the natural resources of the basin. These data will be combined to produce a comprehensive picture. This is scheduled for completion on January 1, 1945. It may develop that certain additional surveys should be made to complete the information.

Problem 5. Power Market. A study of the existing and probable future uses of electric energy will be made. This will cover load centers, rapidity of development, power demands, and load-curve characteristics. Completion of a preliminary report is scheduled for July 1, 1945, and that of the final report, for January 1, 1948.

Problem 6. Economic Studies. It is intended that the plan finally developed will be economically sound and above reproach. Many general rules for measuring the economic propriety of projects have been established by Congress and by the several federal agencies. However, it is possible that, because of the interdependence of projects and the interstate and international aspects of the basin, some changes or additions to these rules would be advisable. A report on this is scheduled for completion on July 1, 1945.

Problem 7. Irrigation. It is recognized that the West must have adequate water for irrigation. To insure this, the first step in planning the use of the waters of the Columbia Basin will be to determine all areas that can ultimately be irrigated, the amount of water needed, and the source of this water. This report is scheduled for completion on July 1, 1945.

Problem 8. Navigation. This study will include potential water-borne commerce and the probable character and dimensions of barges and tugs so that it may be possible to determine the proper channel depths and widths and the stretches of the rivers that should be improved. This report is also scheduled for completion on July 1, 1945.

Problem 9. Flood Control. Many areas in the basin are still subject to destructive floods. It will be necessary to determine which of these should be protected and

SWIFT JOHN DAY RAPIDS ON THE COLUMBIA HAMPER HEAVY RIVER TRAFFIC

the proper means for so doing. September 1, 1947, has been fixed as the date for this report.

Problem 10. Power Generation. While subject to the rights of irrigation and navigation, and to the needs for flood control, power generation is one of the most difficult as well as one of the most important problems to be studied. Answers to the preceding problems will very largely control the solution of this problem. However, so many possible solutions still remain that it will be necessary to resort to a certain amount of cut-and-try to produce a proper plan. This will be one of the last studies completed and is scheduled for January 1, 1948.

Problem 11. Recreational Development. In many instances, it will be possible and advisable to provide recreational facilities in conjunction with reservoirs or other projects. These possibilities will be investigated concurrently with other work and reported on January 1, 1948.

Problem 12. Power Distribution. The physical difficulties and the cost of distributing electric power from river plants to points of consumption will be direct factors in the development of the river system. A report on this problem is scheduled for July 1, 1947.

Problem 13. Fish Life. It is essential that all feasible means be provided for the protection and perpetuation of fish life, which is unusually important in the Northwest. A study will be made of facilities for enabling fish to pass dams, of the possible reservation of certain streams, and of other means to accomplish this end. A report is scheduled for January 1, 1946.

Problem 14. Miscellaneous. Domestic water supply, stream pollution, little reservoirs for range stock, and other miscellaneous problems will be the subject of a report due January 1, 1948.

Problem 15. Cooperation with Canada. Since a large share of the headwaters of the Columbia lie in Canada, it is essential that coordination be accomplished between the studies made by the two governments.

Problem 16. Legal Problems. The area concerned involves five states and two nations, and each of these has laws of its own relative to the use of waters. An inventory is to be made of these laws so that they may be studied and, in so far as possible, coordinated. It may be advisable to note the need for certain changes to permit proper and agreeable development of the river system. This report is scheduled for January 1, 1947.

Problem 17. Priority of Construction. In the light of current and anticipated needs for irrigation, navigation, flood control, and power, and giving due consideration to economic feasibility and to balanced development of the area, a tentative priority of construction will be proposed. This will be undertaken at the conclusion of other studies.

COOPERATION WITH OTHERS

Many agencies other than the Corps of Engineers have a proper interest in and responsibility for one or more of the problems that have been outlined. For this reason, their advice and cooperation are being sought. In some instances these agencies are preparing parts of the report, while in others they are furnishing information and advice. Not all such arrangements have been completed as yet, owing to the progressive nature of the work. Principal among the federal agencies concerned are the following:

Bureau of Reclamation	U.S. Weather Bureau
Federal Power Commission	U.S. Bureau of Mines
Bonneville Power Administration	U.S. Indian Service
Department of Agriculture	U.S. Forest Service
U.S. Fish and Wildlife Service	National Park Service
U.S. Coast and Geodetic Survey	Public Roads Administration
U.S. Geological Survey	

Of the foregoing, the Bureau of Reclamation, the Federal Power Commission, and the Department of Agriculture (Land Use Coordinator) are, together with the Corps of Engineers, parties to the Inter-Agency River Basin Committee. The report will be finally reviewed by this committee, in keeping with its agreement, to assure proper coordination.

The States of Montana, Wyoming, Idaho, Washington, and Oregon are all vitally concerned in this matter, and the success of any plan will be largely measured by its acceptability to them. They are therefore being kept fully informed of progress, and their advice and assistance are sought whenever their respective interests are involved.

Since a large proportion of the Columbia River system lies in Canada, coordination with that country is likewise essential. As already indicated, this is being accomplished through the medium of the International Joint Commission, which has been charged with reporting to the two countries on all matters of joint interest. The Commission made a very extensive field trip through the basin during the past summer. It has set up a technical committee to assist in coordination, and the machinery is now functioning. Canada proposes to study her portion of the river system in a manner very similar to that being pursued by the Corps of Engineers in the United States. She has much work to do, but it appears that her studies will meet the proposed completion date of July 1, 1948.

It should be borne in mind that the investigations which have been discussed are for the purpose of making a plan for the economical and balanced development of the Columbia River system. This plan will be the conclusion of the report to be submitted to Congress. It is then anticipated that, whether future projects are built by private or by public agencies, they will be in accordance with the blueprint thus established. In this manner, a proper and orderly development of the vast and invaluable Columbia River system will be realized.

The Engineers Will Come Through

Accomplishments of the Army Engineers in Thirty Different Types of Unit

By BREHON B. SOMERVELL, HON. M. AM. SOC. C.E.
LIEUTENANT GENERAL, U.S. ARMY, COMMANDING GENERAL, ARMY SERVICE FORCES

NUMEROUS accounts have been printed describing the remarkable speed, skill, and ingenuity displayed by Army Engineer outfits. Seldom have the reasons for such success been explained. Reviewing the task already completed at home and abroad, General Somervell cites three factors which have helped the engineers to become the smooth-working machine that carries our fighting forces forward: they started early; they trained thoroughly; they are supplied with superior equipment. This article is adapted from an address before the Metropolitan Section.

FORTUNATELY, in this war, for the first time in our history, we undertook substantial preparations prior to the outbreak of actual hostilities. One of the major factors, if not the major factor, in this preparation was the construction program of the War Department. It was necessary to build camps in which to house and train our troops; to build airfields for the training of the air arm; to construct storage depots and port facilities to handle the supplies and equipment of the Army; to construct all types of munitions plants to produce those supplies and equipment. This construction program, which got under way early in 1940 and which was the largest construction program ever undertaken in this country, involved every type of engineering and every type of engineering problem, including some new ones that we had never heard of before.

As of the end of November 1944, the Army's construction program in the continental United States amounted to 10.2 billion dollars. It involved the construction of 500 camps, 765 airfields, 167 storage depots, 150 major munitions plants of various types, plus hundreds of other miscellaneous facilities. At the height of the program, in July 1942, the Army was placing construction at the rate of three quarters of a billion dollars per month. It was employing directly or indirectly more than one million workers, the majority being contractors' employees, and had 250 architect-engineer contracts and 3,400 construction contracts in force.

In addition to the construction program here in the continental United States, a major program was undertaken in such outlying bases as Hawaii, Panama, Bermuda, Trinidad, Brazil, and Iceland. This program involved major airfields, housing, port, and storage projects, and amounted to another billion dollars.

The construction program here in the United States and in the outlying bases was substantially completed in the fall of 1942. The highly successful completion of that program and the record-breaking time in which it was completed, is a high water mark in the history of the civil engineering profession and the construction industry of this country. It was a magnificent job. But it did not end the role of the engineers in the war.

One commentator who recently returned from a trip to France reported that one of the impressive things to him about an army in an active theater of operation was the vast amount of work that had to be done to support the actual fighting. He said that this work almost overshadowed the fighting. He likened the invasion of Normandy and General Eisenhower's push to the German frontier to the digging of a Panama Canal through the length and breadth of France. Of course this aspect of war is well known to, and recognized by, professional soldiers. A great part of all this effort to support the fighting troops falls to the lot of the engineers.

The engineer troops in the Army constitute 8.7% of its total strength. In addition to the combat engineer battalions with each infantry division, and our general service regiments which constitute the greater part of the engineer troops, the Army has and must have such specialized engineer units as water supply companies, port construction and repair groups, petroleum distribution companies, power plant repair companies, topographic battalions, forestry battalions, salvage and dockage companies, refinery-tank construction and pipe-fitting companies. In all, there are 30 different types of engineer units in the modern army.

The activation and training of all these engineer troops was the second big engineer job in the war. Seven major training centers have been in continuous operation since 1942 for engineer troops. Every effort has been made to utilize the construction and engineering experience of draftees to fill up the units required. At the end of November 1944, engineer troops totaling about 700,000 officers and men had been organized and trained. Of this number, more than 500,000 are now overseas. They were organized into approximately 1,800 units.

In the main, these troops were not organized and trained by regular engineer officers. There just were not enough regular engineers for the job. Rather, the job has been done by personnel of the engineering profession and construction industry. That too has been a magnificent job. It is remarkable how quickly a trained engineer becomes a qualified and full-fledged Army officer. I know of no other profession from which a person can step from the civilian role into the military

WHERE THE MAIN PROBLEM IS TRANSPORTATION
A Landslide on the Burma Road

DRAINAGE—AN ENGINEER PROBLEM
Clearing the Way for Water to Escape from a Highway in France

role so quickly and so successfully. I attribute this, in part at least, to the fact that engineers and construction men, as a profession, are experienced in organizing men and work and are qualified in the handling of men.

Troops trained for overseas duties cannot perform the expected jobs unless provided with the best possible equipment. American industry, universities, and other inventive genius have all contributed to the many new developments that have occurred in the last three years in construction equipment and materials for military uses. The Corps of Engineers itself has spent over six million dollars on new development projects. A sizable sum in terms of effort and experimentation has been provided also by private enterprise and technical schools. The results will do much for the advancement of engineering science in the years to come.

It has taken tremendous quantities of engineer equipment and supplies to keep our Army in operation. In the calendar year 1943, the Army Service Forces, through the Corps of Engineers, bought nearly $1,500,000,000 worth of supplies. The largest single category was general engineer equipment amounting to over $600,000,000, and another $400,000,000 went for construction equipment. In addition, we spent $200,000,000 for crawler-type tractors alone. In 1944, our total engineer supplies and equipment amounted to nearly two billion dollars and in 1945 we must again purchase $1,700,000,000 worth of supplies through the Corps of Engineers. This is only slightly less than the production of 1944 and considerably in excess of that of 1943.

A construction program of 11 billion dollars, the raising and training of 700,000 engineer troops, and the provision of construction equipment and supplies have been outstanding achievements. But these were only the preparatory steps in the role of engineers in this war. The end-result is in the active theaters of operations overseas.

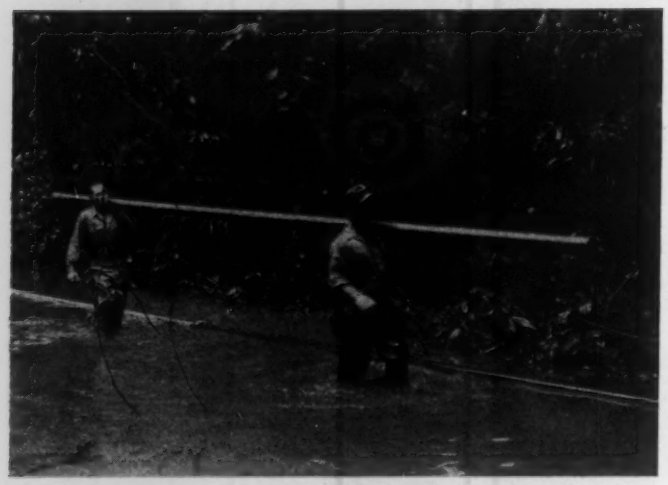
Engineer troops participated in the initial landing in Normandy. Much hasty and arduous construction work was necessary to fix the beachheads so that the vast volume of supplies and equipment could be unloaded and moved forward without delay. The construction of airfields in France began with the first few hours of the invasion. To date, over 130 airfields have been constructed in France. Roads have been built, railroads have been repaired and operated, ports have been reconstructed and opened up to shipping. The communications network, partially destroyed by the Germans, has been restored and is in operation. Facilities for the storage and handling of supplies and equipment have been constructed.

One of the most recent operations is the engineering work just now being finished along the Albert Canal. When the Germans withdrew from Belgium and southern Holland, leaving the canal in our hands, they naturally wanted to make sure that we would not use that important waterway. In the hundred miles between Antwerp and Liege, they destroyed 200 bridges and dumped the wreckage into the canal. They blew up the locks and three concrete bridge spans into the water in front of the lock gates. They sank vessels across the channels, dynamited the walls and bulkheads.

British and American Engineers divided the job of restoration. In the American sector our battalions yanked 60 bridges out of the canal in two weeks. Repair crews went to work on the locks almost as soon as the enemy had fled. Others started to construct necessary bridges to speed the flow of vital traffic to the battle zones. They worked around the clock on the new bridges and the new lock gates. Captured German derricks, pile drivers and draglines, arc-cutting tools and concrete mixers were dragged to the job and put to work. Steel girders came from a captured German mill in Luxemburg; lumber for bridge floors was hewn from nearby Belgian woods by an American Engineer forestry battalion. They got the canal open and it is now being used as a supply line for the Allied armies.

Another example will illustrate the type of work our engineer troops are doing in France. One railroad line ran south from the Normandy peninsula into the heart of France. The Germans destroyed this line systematically as they retreated. Our own Air Forces had helped by blasting many bridges and yards.

On August 13, 1944, the German lines broke and fell back and our spearheads took after them. The breakthrough disorganized the enemy. If we could exert continuing pressure, following up our early advantage, our field commanders realized that we could exploit those



ENGINEERS CARRYING IN SECTIONS OF INDIA-BURMA-CHINA PIPE LINE WHEN JUNGLE RAINS STOPPED VEHICLE TRANSPORT

early gains. But it required great quantities of munitions and supplies to continue the push. We had these on the beach and it was necessary to haul them forward somehow. Roads were few and badly battered, not equal to the task.

General Patton on the morning of the 13th asked the impossible. He insisted that the railroad be rebuilt and the munitions trains start running in 48 hours. The job they set themselves was this: Grade and lay the ties and tracks on some 45 miles of line so badly blasted by our guns and the enemy's, and by our bombers, that many miles of it amounted practically to laying a new line; build seven bridges; reconstruct three railroad yards; and provide watering facilities where water towers had been destroyed.

SOMEWHERE ON THE LEDO ROAD, IN NORTH BURMA
A Survey Party on Elephants Passes a Bulldozer

Forty-eight hours after the order to rebuild the line had been received, the first trainload of supplies rolled across the new bridge at Ste. Hilaire de Harcourt, the last of the seven bridges to be replaced. Ahead lay a clear line all the way to the Seine.

ROADS IN PERSIA

When we move around the globe to Persia and India, we find a different situation. The engineering and construction work is generally new work of a more permanent nature. In Persia the problem was one of opening up a permanent supply line through a poorly developed country into Russia. A new modern seven-berth port was built at Khorramshahr at the head of the Persian Gulf. The Iranian State Railway, which was little more than two streaks of rust, was modernized and turned into an efficient 1,000-mile fast freight system with a capacity of 130,000 tons per month. In July of 1944 it actually hauled 171,000 tons—25% more than the estimated peak capacity. Plants were constructed for the assembly of airplanes and motor vehicles. Airfields were constructed for an air route into Russia.

DEMOLITION—AN ASSIGNMENT OF ARMY ENGINEERS
Blown-Out Pillbox Embrasure in Siegfried Line

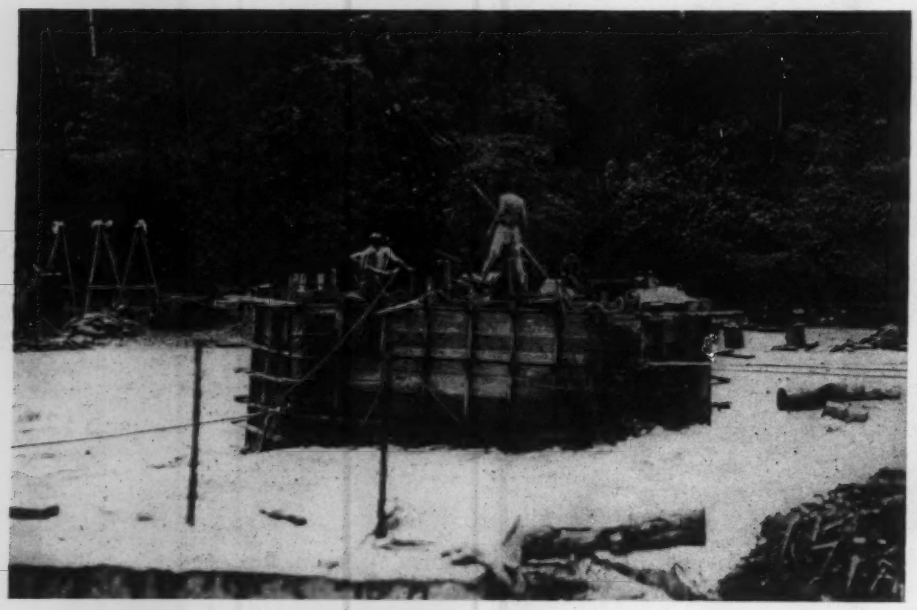
The road construction job in the Persian Gulf Service Command was divided into two parts. From Khorramshahr north to Andimeshk ran an ill-defined camel trail. U.S. Engineers took over the construction of a hard-surface road over this stretch of desert. A new type of soil-asphalt base that could be produced locally was developed. This section of the road was completed in five months when it had originally been estimated that it would take a year.

From Andimeshk to Kazvin was 474 miles of gravel surface with occasional stretches of asphalt which had been constructed by the British with the use of Iranian labor. U.S. Engineers reworked and improved 50% of this route, using modern equipment and accepted Engineer practice. Despite spring rains which washed out bridges and 23 miles of road, the entire route was ready for full traffic in June 1943. Altogether 100 American technicians and 2,500 enlisted men and officers maintained and bettered 435 miles of highway. They produced sufficient gravel on the scene for maintenance operations, operated snow-removal teams to keep the road open during the winter months, and constructed 15 special road camps without slowing the northward flow of aid to Russia. Along with these major items in opening up a supply line to Russia, provision had to be made for housing, storage depots, shops, hospitals, and all the other supplementary facilities required.

PIPE LINES IN INDIA AND BURMA

In India we again find that the main problem is one of lines of communication. When the Japanese cut the old Burma Road, we took to the air to get vital supplies into China. That air route has been inadequate. With the present state of development of the airplane, we just can't expect to supply a large army by air.

A road was essential and a decision was reached early



BRIDGE-BUILDING—NOT ALWAYS EASY, EVEN FOR ENGINEERS
In New Guinea Strong Currents Caused by Torrential Rains Complicate Placement of Bridge Piers

in the war to build one from Assam, the northeastern province of India, into Burma. It has been the toughest road construction job ever attempted. The route is through virgin country; it crosses broad rivers, immense tracts of jungle, and climbs some of the worst mountains in the world. Heat, disease, and enemy patrols have taken a heavy toll of our workers. But the road is going through. The worst natural barriers lie behind us. Before too long we hope to break through to meet the work crews pushing down from the north along the old Burma Road.

PIPING OIL INTO BURMA

The supply of gasoline into Burma has been an extremely difficult problem. Originally fuel had to be hauled over the railroads from the ports of India to bases in Assam, and there are two different gages into Assam. From there gasoline and oil were flown over the Hump to Chinese airfields for our airplanes. The tempo of the war speeded up there on the border, and an immediate need arose for additional supplies of arms and ammunition. But the gasoline haul used up thousands of cars vitally needed for this other matériel.

So the Engineer troops laid a pipe line all the way from the docks of Calcutta to advance outposts in the North Burma jungles, with pumping stations where required. Part of the elevation on the pipe line is 4,000 ft. The Engineers used light invasion-type pipe, 4-in. and 6-in. sizes, which can be laid quickly in flat country. The pipe is shipped with the smaller size inside the larger. A single pipe-line company, given a good access road and plenty of motor trucks, can lay many miles of this line in a day. I saw them do it in France. But in India and Burma the country isn't flat; there aren't enough trucks; the climate s the worst in the world; the enemy fights stubbornly to hold our crews back every mile of the way.

Part of the line is in operation, hundreds of miles of it, and planes are getting gasoline and oil deep in Burma. The trucks which formerly carried fuel now can haul munitions and other supplies. It is a great military accomplishment.

It is in the Pacific, however, that the Engineers have faced their greatest challenges. I suppose there is no other theater where the triphibious nature of this war is more clearly demonstrated. The air arm, the sea arm, and the land arm must combine to push the Japanese steadily back upon their homeland. Engineer troops have played their part in all three elements.

A RECORD OF SOLID ACCOMPLISHMENT

The Engineer special brigades of General MacArthur have played a major role in the steady advance which in 15 months has covered 2,000 miles to the Philippines. Engineer boat crews operate the landing craft which have hauled our infantry from one island and base to another—from Nassau Bay to Leyte, and now Mindoro. One Engineer special brigade in New Guinea put up its own boat assembly plant to weld landing craft together from parts shipped from the United States. It did so well that this idea has been adopted for other theaters. Engineers in Australia designed and built their own combat unloading barge, a shallow-draft armored craft which looks like the Merrimac of Civil War days with the addition of a heavy-lift derrick boom. It can put ashore almost anything, any place, any time, without benefit of deep water or docks.

It seems to me that one of the major, if not the major advantage that we have over the Japanese in the successive conquest of the islands of the Pacific is our ability to make those islands into major military bases. With our construction troops, construction equipment, and modern construction methods, we can and do make an island or a key point on the coast of New Guinea capable of supporting a much superior force and a major base for future attacks.

The story of Army construction in Canada and Alaska has been quite well told; the Alcan Highway, the Canol Project, the construction of airfields and air routes through Canada and Alaska to Siberia. We all recognize these projects as engineering feats of the first magnitude. The significant fact of engineer accomplishment, however, is that similar feats are being done every month, every week, every day, all over the world wherever we find our troops. A great deal of the success of our armed forces can be directly attributed to the "know-how," the modern construction equipment, and the men of the engineering profession.

What has so far been accomplished is outstanding. However, the job is by no means finished. Plenty of hard work, plenty of fighting still lie ahead of us before the ultimate victory in this war is won. As the tempo of the war increases, the troops overseas demand more and more from us here in the United States. The production of the necessary tools for final victory is far from an accomplished fact. We need more production. We'll need it down to the very end. But no matter what the emergency in this country, military or civil, the Engineers have always come through. They will come through in this one. There will be no bombast, no bragging, just the solid accomplishment on which their reputation rests.

A Rational Approach to Stream Pollution Studies

By F. W. KITTRELL

SANITARY ENGINEER, HEALTH AND SAFETY DEPARTMENT, TENNESSEE VALLEY AUTHORITY, KNOXVILLE, TENN.

IF the need for stream pollution abatement is recognized in a community or in a region, why is nothing done about it? The answer often may be found in a lack of understanding of the basic factors involved. Mr. Kittrell points out that objections to abatement can be eliminated if a well-planned educational program follows a thorough investigation of pollution in the area. This article is condensed from an address delivered before the Knoxville Sub-Section of the Tennessee Valley Section.

STREAM sanitation is a subject to which considerable popular discussion is devoted. Practically everyone appears to favor a reasonable program of pollution abatement and control, yet a comparison of conditions from year to year indicates progressive increases in both the intensity of pollution in certain stream sections and the total stream mileage adversely affected by pollution.

Why is the encroachment of pollution permitted to continue? Some of the reasons that might be advanced would include the cost of waste treatment, technical difficulties of treatment, lack of equitable legislation, and opposition to control by those who fear that a program of abatement and control might force existing industries out of business or prevent the establishment of new ones. All these objections may be answered by examining the experiences and accomplishments in several states where wise and vigorous leadership, adequate and reasonable legislation, and a well-planned educational program have overcome these and other difficulties and achieved successful pollution control.

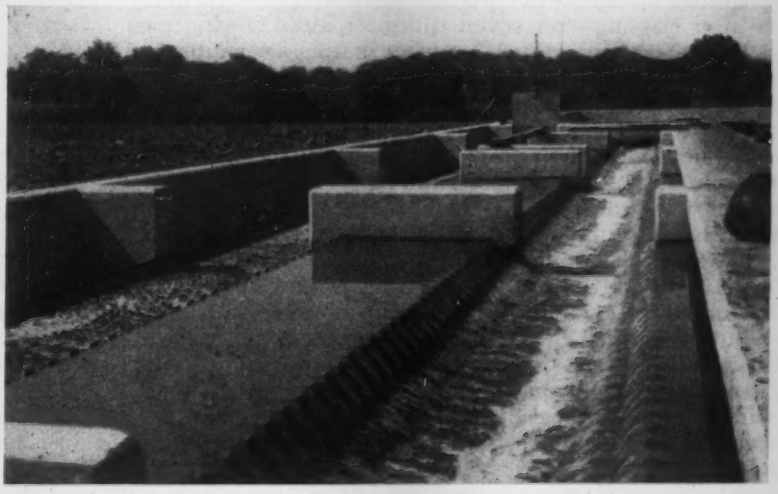
The layman, in order to judge whether he should support a stream sanitation program, needs to know a number of things about stream pollution. He needs to know, in a general way, something of the effects of pollution, whether it endangers the potability or increases the cost of his water supply; interferes with his use of surface waters for recreation, including swimming, boating, and fishing; causes a nuisance due to odor and unsightly conditions; or damages the value of his property through interference with some use to which he might wish to put the water. He needs to know what his share of the cost might be, in the form of taxes, for municipal sewage treatment. And he needs to know whether such a program is feasible, whether it has a reasonable chance of success, and whether it might react unfavorably on the economy of his section as a whole through preventing the establishment of new industries.

In addition to these facts, the manufacturer needs to know in what way his wastes affect the uses of water below his plant; what treatment of them will cost in terms of initial capital outlay and operation expenses; whether treatment will guarantee him against liability for the condition of the stream below his plant; and whether the program will guarantee that his industrial water supply will be free from pollution originating upstream from his plant. The engineer must answer all these questions in addition to the more technical details required to abate the nuisance successfully.

In the first place, what constitutes pollution? From a strictly theoretical standpoint, anything in a stream other than water is pollution. This includes atmospheric gases and soluble minerals from the earth that are present in all streams, even the purest, to a greater or lesser extent. These materials not only are not objectionable, but actually are beneficial in helping to support aquatic life and to render water palatable. Even the majority of the bacteria in water are beneficial rather than harmful. Pollution, then, from the practical standpoint, may be defined as any substance present in water in concentrations sufficient to interfere with normal uses. Polluting agents may be classified as: living organisms, including bacteria; organic matter; and inorganic, or mineral, matter. These three may enter water from many sources—municipal sewage, industrial wastes, or the soil.

The organic matter in water is decomposed by bacteria which develop in proportion to the amount of food below a source of organic pollution, and die off as they exhaust their food supply. In addition, the bacteria are reduced by the forms of plant and animal life that feed on them and by exposure to the unsuitable environment in which the bacteria, particularly those having their origin in the bodies of warm-blooded animals, must exist. The mineral matter settles to the bottom if in suspension, or if in solution may continue in the stream until it reaches the sea.

Pollution by pathogenic bacteria affects the utilization of the stream as a source of potable water and for recreation, owing to the hazards of disease transmission. Organic pollution, in the process of decomposition by bacteria, reduces the normal dissolved-oxygen content of the stream and may inhibit or even destroy fish and other aquatic forms of life which are dependent on the dissolved oxygen for respiration. If the oxygen is completely



POLLUTION CAN BE ELIMINATED BY PROPER OPERATION OF A DISPOSAL PLANT

INDUSTRIAL WASTES INCREASE WATER TREATMENT COSTS
Scum on Water Plant Sedimentation Basin

utilized, foul odors of decomposition are given off by the stream.

Certain organic compounds may impart color, taste, and odor to the water, and a few may render it toxic to aquatic life and to human beings who drink it. Both organic and inorganic wastes may contain insoluble matter that causes turbidity, which interferes with the normal development of aquatic life and, upon settling to the bottom, forms deposits that destroy the feeding and breeding grounds of fish. A few soluble inorganic wastes utilize dissolved oxygen by direct chemical reaction, and others may cause acidity, excessive alkalinity, hardness, color, taste, odor, or toxicity.

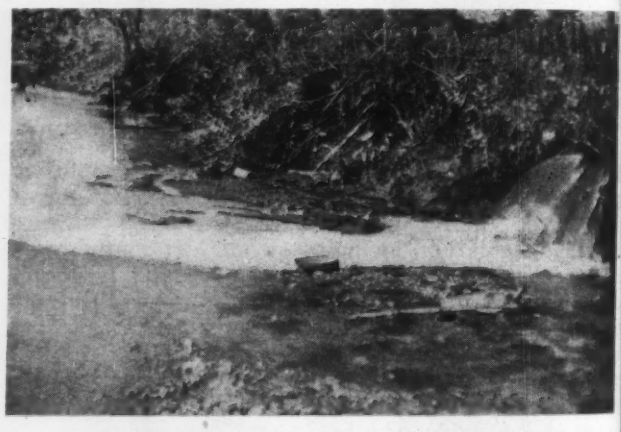
From data obtained from samples collected at several points on a given stream below a source of pollution, it is possible to plot the course of natural purification for that particular stream. From these data and the resulting curves, constants may be derived which can be used to predict the course of natural purification under conditions other than those which existed at the time of sample collection. These curves are based on the time of flow between the source of pollution and the point under consideration, since time rather than distance below the source controls the amount of purification that takes place between the two points. This shows the fallacy of the popular belief that distance is the main factor in purification, that water purifies itself every seven miles, or after passing over seven riffles, or after flowing past seven patches of gravel, or after having accomplished any of numerous other feats commonly supposed to play an important part in natural purification, most of which appear to be connected with the popular number seven.

A knowledge of the rate of natural purification is extremely important in determining permissible uses of water below a source of pollution and the amount of pollution that may be introduced at a given point without interfering with downstream uses.

Bacteria multiply rapidly up to a peak, which usually is found a few hours be ow the point at which the organic pollution entered the stream. Below this point they die off rapidly for the first two days and much more slowly thereafter. A plotting on semi-logarithmic paper of the numbers found at various downstream points against the time of flow from the point at which the maximum number occurs, consists essentially of two straight lines, one having a steep slope and the other a more gradual slope. The two lines merge into each other in the section of the curve where the more rapid first rate of bacterial reduction gives way to the slow final rate. Under average conditions, roughly 10% of the origin maximum number of bacteria w remain after two days and abo one-tenth of 1% will remain aft seven days.

Temperature is an importa factor in both the numbers of ba teria carried in sewage and th rates at which they die off in stream. In summer the averag per capita contribution of bacter typical of the human intestinal trac is about four hundred billion pe day, while in the winter the numbe is about one-third of this. On th other hand the bacteria die off mor rapidly in summer than in winte so that these two factors tend t balance each other.

When the organic pollution a various points below the source, as measured by the bio-chemical oxygen demand, is plotted against time on semi-logarithmic paper, a straight line is obtained. The oxida-tion of the organic material follows the course known in chemistry as a unimolecular reaction. This means that the amount of the material that will be oxidized in a given unit of time is a certain constant percentage of the ma-terial remaining unoxidized at the start of the time unit, regardless of the point that may be selected as the begin-ning of the time interval. For sewage at a temperature of



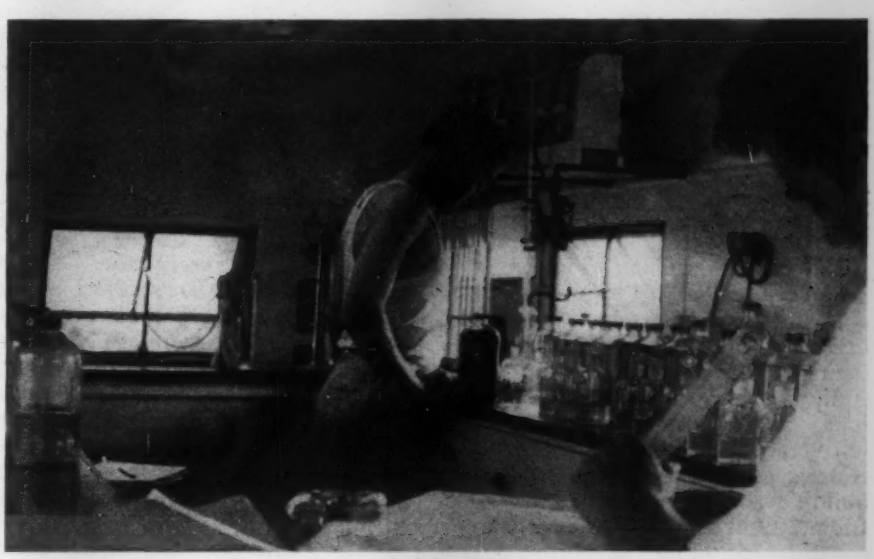
DISCHARGING SEWERS, MOST COMMON SOURCE OF STREAM POLLUTION

68 F, about 21% of the oxidizable material remaining at any time will be oxidized in the following 24-hour period. Thus the total amount of material oxidized, and correspondingly, the amount of dissolved oxygen utilized in the stream during the first day after the sewage enters it at 68 F, is roughly equivalent to the total amount oxidized during the second through the fourth day, and during the seventh through the twentieth day. Temperature is important in the rate at which the organic matter is oxidized. At 41 F about 11% of the material will be oxidized in one day; at 68 F this amount will be 21%, and at 86 F it will be 30%.

At any point below a source of organic pollution, the dissolved oxygen content of a stream represents a balance between the rate at which the oxygen is utilized in oxidizing the organic matter, and the rate at which it is absorbed by the stream from the atmosphere, plus in certain cases the rate at which it is liberated in the water by

some forms of aquatic life. When the dissolved oxygen at various points below a source of organic pollution is plotted against time, a typical curve, commonly known as the oxygen sag curve, is obtained. During the first 24 to 48 hours, depending on temperature, turbulence, and depth of the stream, a sharp drop in dissolved oxygen occurs, owing to the fact that the oxygen demand exceeds the amount of oxygen absorbed from the atmosphere. At the point where the oxygen demand equals the oxygen absorption, the curve levels off and then turns upward as the oxygen absorbed progressively exceeds the oxygen demand. The rate at which the oxygen returns to the stream in the lower reaches is considerably slower than the rate at which it is removed in the section of the stream just below the point where pollution enters. The initial drop in oxygen content and the eventual reversal of the trend, by which oxygen returns to the stream, are due to the manner in which the oxygen demand is exerted, as has been described, the total amount exerted during each successive unit of time being progressively smaller and smaller.

Here again temperature is an important factor. The amount of oxygen that water can absorb is less at high than at low temperatures, and therefore a stream above a source of pollution has less oxygen available for the oxidation of organic matter at higher temperatures. Unfortunately periods of high temperature frequently coincide with periods of low stream discharge, resulting in further reduction in the amount of available oxygen. In addition, the rate at which decomposition proceeds and oxygen is utilized is greater at higher temperatures, as previously noted. All these factors combine to make the stream pollution problem generally more critical in summer than in winter in many areas.



INTERIOR OF A MOBILE TESTING LABORATORY USED BY THE TENNESSEE VALLEY AUTHORITY TO STUDY STREAM SANITATION

ABATEMENT METHODS

How may pollution be reduced at its source if the natural purification capacities of the receiving stream are not adequate? For industrial wastes the methods vary too greatly with the nature of the manufacturing process to be discussed here in detail. They may include recovery of a usable by-product that formerly was wasted; revision of plant processes or operation to reduce loss of materials; or any one or more of numerous methods of waste treatment. For sewage, only one procedure is available and that is treatment. There are three methods of treatment used in this country, which may vary in details of application, but which are based on the same fundamental principles regardless of method of application. These are sedimentation, biological oxidation, and disinfection.

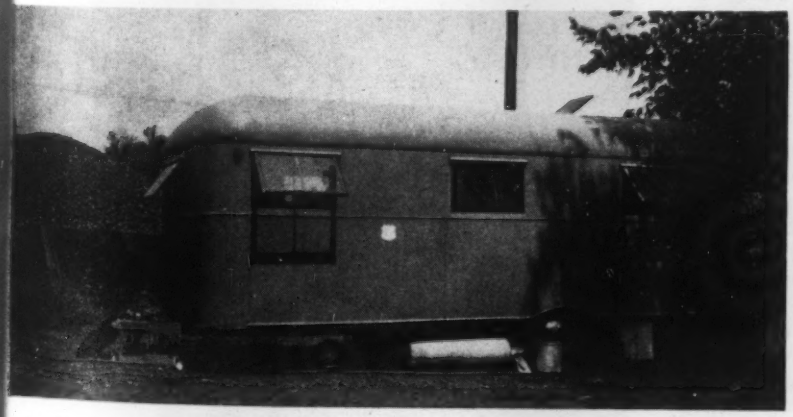
COST REASONABLE

The cost of sewage treatment to be borne by the taxpayer varies, of course, with the degree of treatment required and the size of the municipality. Estimates of the cost per capita, for installation only, range from $6 to $8 for sedimentation and from $10 to $15 for sedimentation followed by biological oxidation, depending on the type of oxidation process utilized. Annual operation costs plus fixed charges for amortizing the cost of installation give average total annual per capita costs of about $0.50 for sedimentation and $1.25 for sedimentation and biological oxidation.

While it is evident that these expenses may total a considerable sum for a given municipality, it can scarcely be claimed that they would impose an unbearable financial burden on the individual taxpayer, who frequently paid as much as the maximum annual treatment cost of $1.25 for a single steak dinner in the good old days. Costs of chlorination, as compared with the costs quoted, are so low as to be almost negligible.

Cost estimates on the treatment of various types of industrial wastes are available in the literature, but they vary so much, not only from one industry to another, but also from one plant to another in the same industry, that no generalizations can be given. Also, such quotations would be meaningless except for the particular plant concerned. But it can be stated with confidence that in most cases well-managed and operated industries can absorb the costs of reasonable treatment without being forced out of business.

Certainly stream sanitation costs money. But, after all, are not clean streams and clear consciences worth something?



EXTERIOR VIEW OF TVA'S MOBILE TESTING LABORATORY FOR THE STUDY OF STREAM SANITATION

Airfields Constructed in the Far East

II. Air-Borne Engineers Provide Fields in Northern Burma

By STUART C. GODFREY, M. AM. SOC. C.E.
BRIGADIER GENERAL, U.S. ARMY; AIR ENGINEER, CHINA-BURMA-INDIA AIR SERVICE COMMAND

THIS is an engineers' war. As General MacArthur has said, "This is an air and amphibious war; because of the nature of air and amphibious operations, it is distinctly an engineers' war. Never before have engineers played such an important role." Aviation Engineer troop units were initiated by the War Department in 1940. Since then they have grown to over 100,000 men. While many units have built airfields, the Aviation Engineers have generally carved out the forward fields. In this article General Godfrey describes work on fields built in the Burma Theater. In the previous issue he told of work in China and India.

IN Northern Burma aviation engineer troops have come into their own. The first troops of this type to reach this theater, with their abundance of earth-moving equipment, were employed on the Ledo Road, and some units are still [November 1944] so occupied. Others came for the specific purpose of building the super-bomber fields in India. Still others, under Air Force control, including air-borne engineers, furnished the detachments that worked with Cochran in Burma, and later undertook repair and construction of airfields in the Myitkyina area.

Airfield construction in Burma, another combat area, is the responsibility of the Air Forces, except that General Pick, SOS, builder of the Ledo Road, has constructed also the airfields immediately adjacent to the Road in what is now the rear area.

The air operations in Burma have been characterized by some outstanding performances on the part of our air-borne aviation engineers. When this new type of unit was created in 1942, their use in gliders as well as in transport planes was visualized, and the special types of light equipment were designed accordingly. In the Southwest Pacific theater, air-borne engineers have been extensively and successfully used, but not, to my knowledge, in glider-borne operations.

In Burma, however, the practicability of gliders for transporting air-borne engineers has been brilliantly and audaciously demonstrated. During the dry season of early 1944, a detachment of these troops, operating under Cochran's Air Commandos in support of Wingate, was flown at night over high mountains into "Broadway." This site, far behind enemy lines, had been reconnoitered only from the air. It appeared to be a smooth, grassed clearing—but the ruts that were not visible to the eye from the air played havoc with the landing gear of the gliders.

These air-borne engineers unloaded their equipment and went to work—dragging crashed gliders out of the way, laying out a landing strip for the transports that were to follow soon. Captain Casey, their gallant commander, was killed in the initial crash landing, but his lieutenant took over and carried on. By the next evening a lighted field was ready to receive, without mishap, the landing of several scores of planes loaded with Wingate's men.

Four other similar missions were carried out by detachments from this air-borne company, operating with fine spirit and taking part at times in the defense of some of these fields from air and ground attack. The company received the personal congratulations of General Arnold.

These airfields were comparatively simple jobs, for fair-weather use only. I inspected one of them in order to estimate the effort it would take to make the field capable of operation during the monsoons, and had to conclude that, in general, the considerations which governed the air invasion did not yield sites advantageous with respect to material available and drainage for year-round development. These fair-weather fields, it was demonstrated, could be readily prepared by small detachments of men and air-borne equipment. The grading work in most cases was quite light, although on one terraced rice paddy a 5-ft difference in elevation had to be overcome.

Another lesson learned was that such operations are costly in equipment, as about half the total number of bulldozers, gliders, scrapers, and tractors employed were either broken up in landing, destroyed by enemy action or, as happened in more than one case, abandoned when a field was hastily evacuated.

The death of General Wingate removed an outstanding leader akin to Lawrence of Arabia in spirit. His "long-range penetration groups," transported and supplied by air, had introduced a novel technique in warfare—and he expressed to me more than once his appreciation of the "superb" work of the air-borne engineers who had taken part in these operations.

MYITKYINA AIRFIELD

The capture of Myitkyina airfield in May was obviously of great importance. Here was a more searching test of the efficacy of air-borne engineers. This was no fair-weather job, as the monsoon rains were beginning.

Air-borne engineers arrived at Myitkyina airfield on

LOADING DISMANTLED BULLDOZER FOR TRANSPORT INTO BURMA

the day of its capture, the first component being glider-borne. Reinforcements arrived later in transports, and helped with hand grenades to liquidate the last pockets of Japanese resistance. However, the field was so badly deteriorated, riddled with craters and soft spots, that its use for the first day or two resulted in many accidents. To repair, improve, and maintain this field in operation during the monsoons was therefore a compelling job for these air-borne engineers. How they performed was thus described by Major General Stratemeyer in a broadcast from this theater:

"The air-borne engineers are building our fields against terrific handicaps. So well did they do their jobs with the seized air strip at Myitkyina, that during a twelve-hour stretch recently, that field averaged better than one take-off or landing every two minutes—a traffic rate surpassing that of La Guardia Field. And this with Japanese troops only two thousand yards away."

In local command of the initial operation, and of subsequent airfield construction in this area, all of which has been ably performed, was Col. Manuel J. Asensio, Engineer, 10th Air Force.

For a while the air-borne battalion had only its light integral equipment to work with. It used this effectively, paying much attention to drainage, as one drain-

FIG. 1. CHINA-BURMA-INDIA THEATER, SCENE OF OPERATIONS OF GENERAL GODFREY'S AIR ENGINEERS

age ditch 10 ft deep, excavated entirely with a $1^1/_2$-yd scraper, testifies. Fortunately the battalion had an "ace in the hole" in the shape of a complete set of heavy equipment back in Assam. Air-borne engineers are trained to operate heavy, as well as light equipment. Just as soon as the combat situation permitted, therefore, this heavy equipment began to arrive by air. It was not long before the battalion at Myitkyina had opened up a gravel quarry and was working it with a $1^1/_2$-yd shovel and fourteen $2^1/_2$-yd trucks. Bulldozers of the D-7 type appeared on the airfield alongside the smaller ones, while motor-patrol graders with 12-ft blades kept the well-graveled runway in good shape. Here was another job for the troop carrier and combat cargo units of the 10th Air Force, which had for weeks provided the sole transportation of food and ammunition for the Ground Forces.

For some months Colonel Asensio had at his disposal only one air-borne battalion. But more help was coming. In recognition of the growing importance of forward airdromes, an additional battalion was assigned to this task. This battalion, a colored unit, was a standard

DEBRIS IS CLEANED OUT OF A BOMB CRATER BY A D-7 TOWED CARRYALL, AT MYITKYINA

aviation engineer battalion, and came from its task of building one of the super-bomber fields. This fresh battalion, like the first, had to move to its new location by air. For months traffic over the Ledo Road had been intermittent, and in any event the point to be reached was far in advance of the completed portion of the road—hence, another air-borne job.

HEAVY EQUIPMENT REBUILT

Soon the colored personnel of this battalion were on the site of a new field, reconnoitering for the location of this field after the fall of Myitkyina itself but before the last pockets of Japanese resistance in the vicinity had been cleared up. Steadily their equipment arrived in daily increments—D-7 bulldozers, graders, heavy trucks, and even 8-yd carryall scrapers with their enormous pans. All this equipment, of course, had to be disassembled, frequently by use of a cutting torch, for air shipment, and painstakingly rebuilt after delivery. The big scrapers in particular require a good deal of cutting and subsequent welding. We understand that this particular item of equipment has not previously been thus transported in a military operation.

Before the end of November 1944, the 20,000th transport plane had landed and taken off from Myitkyina airfield, each bringing in its 3-ton load of troops, supplies, or equipment. Fighter activity at times had been almost as pronounced. Nor had the forward movement of aviation engineer troops ceased, as more units were needed for the construction of additional airfields to support the advance of the ground forces and for the Air Transport Command. Upwards of 1,000 plane-loads were devoted to engineer troops and their heavy equipment, including, for example, more than two score of D-7 bulldozers. And all this time, until the first convoy came through by road in mid-November, the supply of Myitkyina was largely an Air Force responsibility—magnificently performed.

These operations around Myitkyina have impressed me with the efficacy and flexibility of air transportation. In general, we think of transport by air as a relatively expensive method. Here at Myitkyina, it was the sole means of transport available. But, moreover, I believe it can be readily demonstrated that in traversing jungle-covered, rugged terrain, the air transport will have advantages over the road in many ways. Under such conditions one C-47 plane can do the work of a dozen or more $2^1/_2$-ton trucks. The plane is roughly comparable to the equivalent number of trucks in initial cost, and lasts

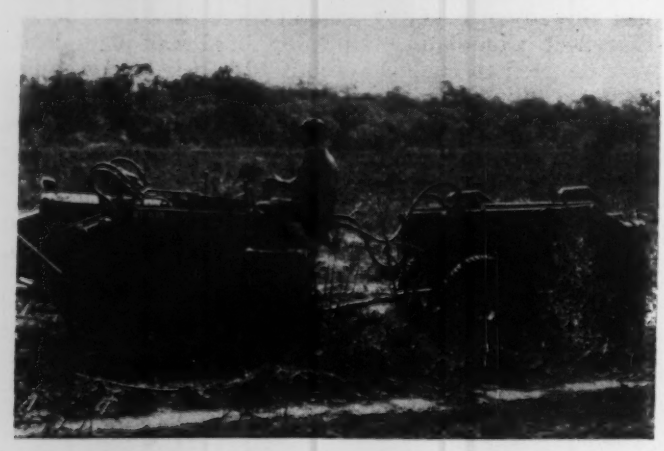
many times longer. The manpower required to operate and maintain the planes is much less than for a comparable fleet of trucks. The effort required to build and maintain the airfields is immeasurably less than that required to carve out and maintain a virgin road through such country. Certainly supply by plane is more flexible and speedy, and (in this theater at least) has proved less subject to interruption by weather.

BURMA FORCES SUPPORTED ENTIRELY BY AIR

Even in a theater of operations where good roads exist and are used to the limit, air transport is being increasingly used to help meet the arduous supply and evacuation problems of modern war. Such use of air transport, at the front, used to be considered an emergency, but reports from France indicate that during the second phase of the invasion, with its rapid advance, air transport assumed tremendous importance in supplementing the railroad, pipe lines, and roads, which could not keep up with the rapidly moving armies. All methods of transport in war are, of course, needed for the fullest utilization, as circumstances dictate. But this operation in Burma, where considerable forces were adequately supported for nearly six months entirely by air, deserves to be studied for its lessons in future campaigns.

For security reasons, not until quite recently have the notable pipe-line projects for the Far East received any publicity. It has now been announced that the "longest pipe line in the world" will eventually fuel China. Meanwhile, completed portions of the lines in India and Burma have already served a most useful purpose in reaching forward airfields and other installations, and greatly reducing the load on other means of transportation. Materials for the pipeline in Burma were transported by train, plane, truck, and raft. This pipe line climbed over mountains 5,000 ft high, and despite floods and monsoon rains, it was completed expeditiously by engineer petroleum distribution companies assigned to the SOS.

As to the airfields built and now building in North Burma, little more need be said except that they are typical field airdromes, built of gravel, which is fortunately available in adequate quantity without long hauls. Some asphalt surfacing is planned for accomplishment later. The first field was substantially completed during the monsoons, despite the handicap of frequent rains. With the advent of dry weather in October progress was greatly accelerated, and several other fields were shortly placed in operation. Drainage, which has received primary consideration, has been facilitated by the use of corrugated metal pipe for culverts, since lumber—owing to lack of sawmills and the desire of civil



AIR-BORNE EQUIPMENT IN SERVICE DEEP IN ENEMY TERRITORY

GRAVEL WAS OBTAINED FROM BANK OF IRRAWADDY RIVER

affairs officials for conservation—is strangely enough a critical material. In the layout of these fields the trend is away from dispersed patterns toward more compact designs, with large parking aprons. In other words, our air superiority justifies taking a somewhat greater risk for the sake of more efficient operation. The engineer provide the essentials—runway, taxiway, apron or hard stands, control tower, water supply, gasoline and bomb storage, access roads—and the troops erect their own tents and auxiliary buildings.

RESEARCH NEEDED

Many problems of research are presented. Let me suggest one of them. An airfield designer wants to build a runway at 6,000-ft elevation comparable in length to a runway 6,000 ft long at sea level. From one standard text, the engineer will find that he should build his runway 9,600 ft long, to correct for the reduced air density at that altitude. From another authoritative source, he is told that a length of 7,500 ft will provide sufficient correction. Further comment as to the need for revision of these formulas seems superfluous.

For the military engineer, airfield building is just a special case of moving and compacting dirt, and paving it as time and available resources permit. The successful airfield builder must have a good practical knowledge of soils. (Thus it is gratifying to know that civil engineering colleges are laying greater stress on their courses in soil mechanics.) He must be familiar with earth-moving techniques—applicable to sand, coral, iron ore, volcanic soil, or to whatever material must be used. He must appreciate the vital importance of drainage. He must be adaptable and resourceful. He must, above all, have a compelling sense of urgency!

As to these Far Eastern theaters, the importance of airfields has been sufficiently indicated. In the scale of operations to date, the Far East has played a minor role compared with the larger operations in Africa, Europe and the Pacific. Its military future has interesting possibilities—as uncertain perhaps as the political future of this vast Asiatic domain. In any event, here lies one of the approaches to Japan, and from here have been launched the first blows at the mainland of Japan by land-based bombers.

Basic Magnesium—the Desert Giant

II. Contractor's Problems and Organization

By SHERMAN MASON
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ONE of the most unusual of the nation's construction jobs in connection with securing materials for the current war was the building of this, the world's largest magnesium plant in the desert lands of the West. Construction methods employed were for the most part conventional; however, the size of the plant, the variety of materials used, and the phenomenal speed with which it was built, place it in a category by itself. Some of the most interesting engineering features are here discussed. For a description of the background of the manufacturing processes involved, reference may be made to the preceding paper, by J. R. Charles, in the January issue.

THE huge plant built for Basic Magnesium, Inc., and financed by the Defense Plant Corporation occupies, together with its appurtenant facilities, an area of 4,000 acres midway between Las Vegas and Boulder City, Nev. Of this area, an enclosure of 1,250 acres contains the plant proper.

No other job in the history of industry has required an equal amount of electrical or sheet metal work, plumbing or masonry. It was the second largest structural steel job in the world. During most of the construction period the weather was so hot that the steel had to be handled with gloves. Bringing this 10-unit plant to complete production in less than two years was an accomplishment in which all concerned felt a justifiable pride.

Ground was broken by the contractor, the McNeil Construction Company of Los Angeles, on September 15, 1941, with general clearing and construction of temporary roads. Land ties were made and benchmarks established. A base line was laid out, parallel to the contour of the land, through the east and west axis of the plant, and a coordinate system built up on this base. The field engineering personnel rapidly increased until it reached a peak of ninety. A spur was built to the site from the Boulder branch of the Union Pacific Railroad. This was augmented, as construction progressed, by additional spurs, until the finished system comprised eighteen miles of permanent track laid with 90-lb and 110-lb rail.

This locality is subject to floods occasioned by flash storms of great intensity. For protection, a ditch 4 ft deep by 9,000 ft long was excavated along the southerly side of the plant; this had a bottom width of 16 ft increasing to 40, with $1\frac{1}{2}$:1 side slopes. Excavated materials were cast up as a dike on the lower side. The main railroad crossed four washes, on fills orginally, to save time. Later the fills were replaced by prefabricated trestles, all the work being done on Sunday with no interruption to traffic.

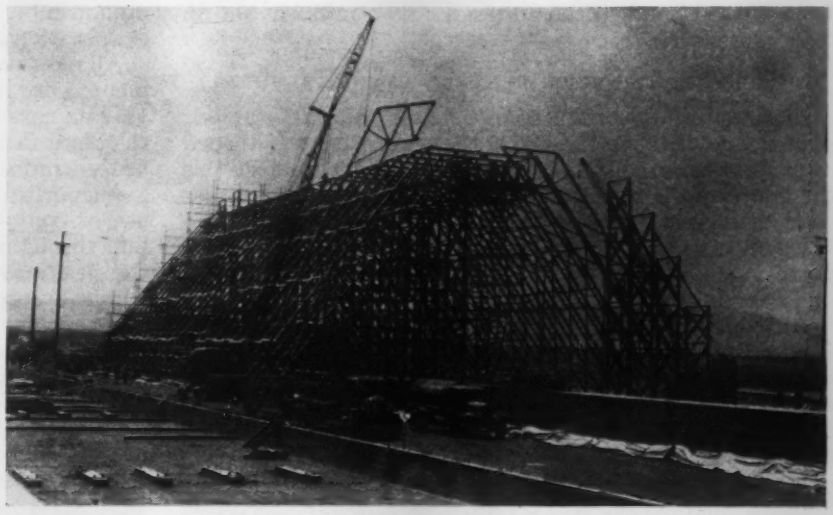
The permanent water supply, from Lake Mead, was stored in a reservoir constructed by another contractor. Before this was ready, arrangements were made to haul water in railroad tank cars from wells in Las Vegas. Two, and then four more redwood tanks, each of 50,000-gal capacity, were installed adjacent to the branch railroad south of the site. A siding for spotting the cars was provided. Topography was such that water could be drained from the cars through wood flumes to the tanks, thence by a 10-in. pipe line, with good pressure, to the plant.

Sanitation for early field forces was provided by portable chemical toilets furnished and serviced by a subcontractor. Pending construction of the permanent facilities, an Imhoff tank was built adjacent to the site of the proposed permanent plant. By the time it was ready to function it was badly overloaded, the project having grown to the third largest city of Nevada. However, $3\frac{1}{2}$ acres of impounding lagoons remote from the main project took care of the effluent without serious inconvenience.

Obtaining aggregates for a quarter million yards of concrete was an immediate problem. Finally a deposit two miles away, containing both sand and coarse aggregate, was chosen, and a crusher and vibrating screens were erected. The sand carried a high percentage of silt but ample water for washing was obtained from a well drilled nearby. Aggregates were hauled to stock piles convenient to a batching plant on the job, where the material was elevated into bunkers by clamshell and then batched into transit mixers.

Concrete proportioning was by the solid volume method. A field laboratory in charge of a McNeil technician was maintained, test cylinders being sent to Los Angeles for crushing. Concrete was placed by all the usual methods, but cranes were used to an unusual extent to reach high places and other points difficult of access. Cherry-pickers placed the cradle for large concrete pipe in deep trenches. Electric vibrators were used, and curing was generally done with wet burlap.

When the project started, detail plans had not yet been prepared, but since it was obvious that large quantities of standard materials would be required, orders were placed



PLACING OF ROOF FRAMING, 90 FT HIGH, FOR PEAT STORAGE BUILDING REQUIRED SPECIAL 125-FT BOOM

REMOVING DEBRIS OF ADMINISTRATION BUILDING AFTER FIRE

immediately and a stock accumulated. This foresight did much to promote construction progress. Plans were delivered by the Basic Magnesium Company to the McNeil Chief Engineer, who issued copies to all interested departments, at the same time definitely assigning specialties, and making each department responsible for requisitioning the necessary material—from stores on hand, if available, otherwise by new purchase orders. About 14,000 separate plans were issued, and the average distribution was 21 copies, a total of approximately 300,000 prints.

As the housing problem was acute, construction of a camp was started promptly. Dormitories housed 34 men each, two to a room, and pyramidal tents with floors and side walls housed five men. Separate bath houses with showers and toilets were provided. The mess hall and camp were operated by a catering company, which furnished beds and bedding and the care of rooms and tents. All buildings and tents were air-conditioned. Finally the camp housed 3,600 men. Later a 668-unit trailer camp was constructed, and equipped with baths and laundries.

A town site built coincidently consisted of 1,000 dwellings, with a business district, women's apartments, school and hospital built by the McNeil Construction Company. Frame dwellings had two or three bedrooms, and were air-conditioned and equipped with electric stoves and refrigerators. A separate railroad siding and storage yard handled the material, and a mill was set up for its fabrication.

DIVISION OF THE WORK INTO ELEVEN DEPARTMENTS

Magnesium was produced in the first unit of the metals plant on August 29, 1942, and the tenth unit was turned over for operation May 28, 1943. To accomplish this the contractor's organization, in addition to administrative, engineering, and accounting forces, was divided into 11 departments: General Building, Utilities, Transportation, Labor, Electrical, Plumbing, Masonry, Roofing, Painting, Sheet Metal, Machinery Setting.

All construction that was not handled by specialized departments was done by the General Building Department. There was nothing unusual about the steel work except that at times sufficient rivets were not obtainable, so only main structure members were riveted and lighter ones were temporarily bolted. While building operations were vast and varied, and speed was demanded under trying labor conditions, methods as a rule were orthodox. Construction of two wood buildings, each 102 by 513 ft and 90 ft high, for peat storage, was an interesting framing job. Their roofs sloped 65 deg fr the horizontal on each side, down from a flat top 12 wide. They were designed for shredded peat deliver by "airveyors." A humidifying system was part of t plan and the triangular cross section kept the air spa within reasonable limits. All roof workers wore safe belts while engaged on these structures. Their size a peculiar shape are a noticeable feature of the skyline.

A number of cylindrical concrete storage tanks we constructed by the slip-form method. One battery co sisted of five tanks 40 ft in diameter and 84 ft high. E posed concrete below the forms was sprayed by a ho operated from a scaffold on the forms. The spraying r moved laitance and assisted the work of the finishers. was continued until the concrete was cured.

All excavation and earth moving were handled by t Utilities Department, which also provided and operate cranes and equipment for installing heavy machiner pipe and structural parts, and in addition operated service garage and maintenance repair shop, and t magnet-equipped truck which patrolled the grounds t pick up nails. It also constructed, among other device a boom extension by means of which a $2^1/_2$-yd dragli was converted to a crane with a 125-ft boom.

Excavation methods were conventional. Having i mind the uniform slope and even contour of the countr it is easy to visualize the plant as occupying a series o broad terraces. The site for each group of buildings wa roughed out to floor level with shovels and dragline Excavations for basements and footings of individua buildings followed.

DISPOSAL OF LIQUID WASTE BY EVAPORATION

Disposal of liquid waste was provided for by fou ponds with a surface area of 90 acres. Later, additiona evaporation surface was required and a tract of 1,60 acres, a mile northeast of the original set of ponds, wa laid out in beds. These consisted of dikes $5^1/_2$ ft high built along the contours. Lateral wing dikes were abou 500 ft apart and ditches around their ends made th ponds interconnecting. Effluent was delivered through the overflow pipe from the original ponds, thence dow the center of the tract through a distributing ditch pro vided with concrete diversion weirs. Main dikes were purposely designed with a top width of 10 ft to permi the use of 15-yd carryalls. Water was supplied by truck sprinklers, and the passage of equipment over the dikes did the tamping. For this project, one and one-hal million cubic yards of earth was moved, and 631 acres o evaporation surface was provided.

All passenger automobiles, and other light motor equip ment, were handled by the Transportation Department Private cars were not permitted on the job. The size o the plant made it necessary to haul workmen from and t the entrance gate. This service was supplied by th Transportation Department, which in addition, by the use of converted pick-up trucks, operated a regular bu line through the plant, giving a 15-minute service. A the peak, 354 pieces of light equipment were operated The movement of 77 pieces of equipment, loaded wit tools, from a project which the McNeil Construction Company had just completed at San Diego, Calif., was an interesting incident. This single train, under police convoy, made the trip in 18 hours.

Common labor was supplied by the Labor Depart ment, which maintained a pool of unskilled labor. Me were assigned to work under the direction of other de partments as needed. The Labor Department also placed concrete and compacted backfill, serviced the drinking-water system, and provided janitor service and

general clean-up. Both white and colored labor were used and there were the usual problems incident to this combination. The Labor Superintendent, in company with all other superintendents, as well as administrative and personnel officers, handled the labor situation with tact and efficiency. There were no strikes or delays of importance occasioned by labor troubles.

DRINKING WATER CONTINUOUSLY DISTRIBUTED

Providing drinking water in a desert country for crews which at peak aggregated 13,000 men, and with a prevailing summer temperature of well over 100 F, was an item of importance. Ice water in 750 ten-gallon and twenty-gallon cans, wrapped in wet burlap, was placed in shaded stalls at convenient points. Paper cups and salt tablets were supplied. Distributing the water as well as collecting and steam-cleaning the cans was a continuous service. At first commercial ice was used. Later, a refrigerating plant which cooled the water to near-freezing temperature was installed. At 24 points, where demand was unusually heavy, insulated 250-gal tanks were placed.

Electric power was obtained from Boulder Dam. An idea of its amount may be conceived from the statement that the plant's annual power consumption equals that of the states of Colorado, Wyoming, Arizona, and New Mexico combined. On the Electrical Department devolved the responsibility for installing the permanent system and also for furnishing light and power for construction purposes. Current was provided temporarily by gasoline-engine-driven machines until December 1941, when the first substation was cut in.

The project included placing 80 miles of bus bars. After 5,000 tons of copper bars had been installed, this material was no longer obtainable, and the work was completed by using 625 tons of silver. A special bus-bar-bending shop was set up, where bars $\frac{1}{2}$ by 8 in. wide, and 18 in. to 12 ft long, were bent cold, by hydraulic equipment, to an inside radius varying from 1 to 2 in. The grounding system consists of 26 wells sunk to water level at depths varying from 50 to 200 ft.

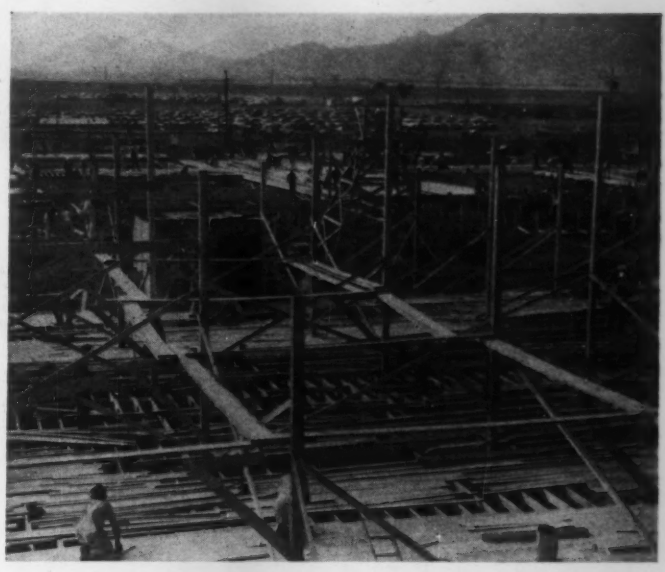
Like other departments, the electric shop produced its share of ingenious inventions. One was a conveyor for installing cable in tunnels. Fifteen hundred feet of conveyor with concave, ball-bearing rollers was built. This included curved sections so corners could be negotiated. The cable handled was $3\frac{1}{4}$ in. in diameter and weighed 10 lb per ft. Its rubber jacket was delicate, requiring very careful handling.

INSTALLATION OF PROCESS PIPING AND UTILITIES

The Plumbing Department handled the installation of all plumbing, drains, and process piping. These ranged from 72-in. concrete drains to the smallest size of copper tubing, and included 22 miles of glass pipe in the hydrochloric-acid cooling system. Four miles of pipe was rubber lined for use in the acid recovery lines.

Installation of underground utilities was interesting. A typical street installation might include a 60-in. storm drain; a sanitary sewer; an acid drain; separate mains for stabilized, boiler-soft, and domestic water; also pipes for the cooling system, both supply and return possibly; insulated steam pipe; and generally one or more encased electric conduits. All had appurtenant manholes, valve boxes, and pull boxes.

The practice was to excavate by dragline or shovel for the storm drain, with a cut benched for sewers and acid drains, to minimize hand work. Tamping was done with air hammers plus a small amount of water. As a rule the main trench was backfilled before smaller water pipes and electric ducts were placed; these, being at shallow depth, were cut in later with trenching machines. Backfill was placed by dump trucks or bulldozers, and generally sprinkled but not flooded.



ADMINISTRATION BUILDING BEING RECONSTRUCTED
Building Was Partially Used on Fourth Day After Fire

Job traffic, which was heavy, furnished compaction. The immediate stability of the backfill was surprising—in no case was settlement observed. Side slopes of large trenches stood generally at between one-quarter and one-half to one. Sheathing was not used except in a few special cases. Trenching and pipe-laying were, of course, coordinated with the building program so that traffic lanes could be kept open and also so as to keep handling of excavated material to a minimum.

MASONRY AND BRICKWORK OF COMPLICATED TYPES

Masonry work threatened to be a bottleneck. Nine million brick were to be placed; this included six million acid-proof brick in a complexity of shapes and ranging in weight up to 150 lb. There was, in addition, the largest floor-tile job, 12 acres of it in all. The first difficulty was to find masons. There were not enough skilled men available locally, and the membership of the masonry unions has been generally decreasing in recent years. The Masonry Department at peak employed 1,760 men, 950 of whom were masons. In order to assemble this crew, bricklayers' locals were canvassed in the entire United States. Application blanks, which explained the problems of the job, were sent out with a request that they be given to experts only. By this method 100 key men were selected from 21 states, and a sufficient force was built up around this nucleus.

Brickwork was a specialty of the English consultants, whose ideas and methods were sometimes at variance with those of the Americans. However, the tact and good sense of all parties avoided any serious friction. Bricks were purchased by the owners throughout the United States. Inspection was rigid and the percentage of culls was very, very high. A few bricks were shipped from England, but these were no more satisfactory than the American product.

Complicated intersections required many peculiar shapes. As work progressed, economies were effected by combining an original design consisting of several small shapes into one large one. For some structures, full-size models were constructed and a plaster cast was made of

COMPLICATED MASONRY WORK ON FURNACE SHELLS OF CHLORINATORS

each shape. After being fitted to the model, the casts were used as master patterns. There being many identical units, assembly-line methods could be used.

Masonry to a great extent was laid up under trying conditions, that is, under electric light and in places difficult of access. In the wash towers, which were 24 in. in diameter, masons worked on tables 3 ft high, placing one on top of another until the last brick was laid from the seventeenth table. For acid-resistant brick, it was necessary to keep the cement at freezing temperature to prevent premature set. Eight million pounds of ice were used, in mixers operated like ice-cream freezers; there were forty of these, each of 3-gal capacity, driven by $^1/_2$-hp motors.

The title of the "Roofing Department" was a distinct anomaly; in additon to placing roofing, this department laid mastic floors and placed acid-proof membrane in manholes, and applied the water-proofing to the electrical distribution tunnel, a structure 10.5 ft by 16 ft, and a mile long.

Original roof specifications called for five layers of 15-lb felt applied with asphalt, gravel covered. Strong desert wind, abetted by daily whirlwinds, blew away the light material before it could be secured, and threatened to take the roofers with it. Substitution of three layers of 40-lb felt was an improvement. Gravel coating was generally spread at night to avoid interference by wind and also to utilize cranes needed for other purposes during the day.

DELICATE JOBS FOR THE "ROOFING" DEPARTMENT

To supply acid-resistant linings for containers, pyroflex and tygon were used, applied by the Roofing Department. Pyroflex, an asphalt product, was delivered in sheets 10 ft square by about $^3/_{16}$ in. thick. A factory engineer spent a week at the plant training McNeil crews. Among the items lined were 26 wash towers ranging up to 89 ft high; 12 turbo-neutralization tanks; drains; and several hundred sumps and manholes. Several coats of primer preceded the application of the pyroflex sheet, which had to be previously warmed until it was about as pliable as leather. It was then fused to the wall with a blow-torch. At first this material was used on cement and brick surfaces only, but later it was successfully applied to metal.

A protective lining was required for 20 metal clarifier tanks and an equal number of sumps. The clarifiers were inverted cones 30 ft in diameter by 15 ft high. The preferred lining was rubber—unobtainable. Instead, tygon was used, in sheets 30 in. by 48 in. and three thirty seconds of an inch thick. After the surface was thoroughly cleaned by sandblasting, six coats of special cements were applied to both the metal and the tygon, the latter being heated in an electric furnace to make it pliable. The sheets were not applied to the metal surface until from 10 to 14 hours after the cement applications. Seams were then sealed with an electric knife. After an electric broom test, the surface was given two coats of a rubber-like "gel" and was finally finished with two coats of tygon paint. Both cements and "gel" were very explosive, requiring rigid precautions against accidents; they also diffused a strong ether-like odor, having a dangerous laughing-gas effect. Men were not permitted to work in enclosed sumps or tanks more than a half hour at a time.

While in no sense a work of art, Basic Magnesium was nevertheless, embellished with 180,000 gal of paint—acid-resistant paint, paint to withstand high electric current, paint for temperatures up to 1,200 C, and paint that was just paint. Some surfaces required 21 coats. The painters painted signs and creosoted railroad ties. Pipes 3 in. to 3 ft in diameter, requiring inside and outside coatings, were dipped, using a small cherry-picker for the heavier pieces. Pipe under 3 in. was painted with a brush placed inside and operated from either end by lines as the paint was poured in. Painters applying acid-resistant paint to the inside of tanks wore masks, and oxygen was pumped to them.

Extreme summer temperatures caused pressure to build up in containers of oil, turpentine, and other ingredients to such an extent that it was dangerous to unscrew caps. Some workmen were burned in this way and liquids were sometimes so hot they could not be used. Steel was so hot that as soon as paint was applied it formed a baked finish.

The Sheet Metal Department, like all others, carried extra responsibilities. Its major concern was ventilation. In addition, it designed, constructed, and maintained the air-conditioning equipment for all temporary buildings and also operated the bus-bar-bending shop.

No account of the construction of this project would be complete without mention of the fire of March 6, 1942. A blaze, originating about 11 p.m. in the heating plant of the administration building, and fanned by a strong wind, reduced the structure in thirty minutes to ashes. It was a well-constructed one-story frame building divided into numerous offices, with $1^3/_4$ acres of floor space. Two fireproof vaults saved the plans and vital records.

When the force reported for work the following morning, temporary space for every department had been assigned in warehouses, shops, and sheds, and posted bulletins directed employees to their quarters. New office equipment was arriving from Los Angeles while bulldozers and trucks were clearing away the hot debris. Men and material were commandeered from all departments, and reconstruction proceeded night and day. On the fourth day, the Engineering Department moved back into its quarters, and one week after the fire all other forces were moving into the reconstructed building. Rivalry between crafts during construction was spirited. Paint was often applied to sheathing before it was completely nailed in place; in fact, the paint foreman insisted that his men were frequently working ahead of the carpenters. A telephone switchboard was flown from Chicago.

The McNeil Construction Company is proud of all these achievements.

Resources of Water and Power Await Development in Puerto Rico

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COMPLETE utilization of the resources of Puerto Rico has become imperative with the growth of the island's population. Studies have shown that, even when fully developed, the island can provide only a limited standard of living for its two million inhabitants—and this figure is growing constantly. In this paper, Mr. Griffin presents some of his personal observations while acting in the capacity of Planning Technician in Puerto Rico for the National Resources Planning Board.

DEVELOPMENT of resources in Puerto Rico is most intimately related to the future welfare of the island's people, even to their very existence. The basic resources of the island are one million acres of agricultural lands and abundant rainfall. But from these two resources may be developed a third, power—power from falling water and power from agricultural products. There are no known exploitable resources of oil, coal, or natural gas on the island. Moreover there is no surplus of goods and services to exchange for oil and coal without detracting from other basic necessities of the people. Mineral and forest resources are scarce and of low value.

The island's economic structure and employment pattern have always been based upon agriculture. Sugar cane, coffee, tobacco, fruit, and food crops are the most important products. Land tenure is controlled by a relatively few people. The best land is controlled by the large sugar corporations. Three per cent of the total number of farms constitute 50% of all the farm acreage. As a result the majority of the rural dwellers are landless agricultural wage earners.

Puerto Rico's resources have been described as abundant for one million people, limited for two mllion (the present population), and meager for three million, but until the island's resources have been completely developed and are fully utilized, it cannot be established that they are insufficient to adequately support the people. The development of resources has not kept up with population growth. With a prospective population of three million people by the year 1960, this adverse relationship may become worse. Puerto Rico, therefore, faces a bleak future unless her resources can be further developed and more intensely utilized. Further expansion of her already highly developed agricultural economy is limited to bringing under irrigation some 28,000 acres of additional irrigable land.

RAINFALL POORLY DISTRIBUTED

The supply of water for domestic and agricultural uses is ample. The Island is, however, faced with problems regarding the apportionment and use of water because the rainfall is distributed unequally both seasonally and geographically. This is especially evident on the south coastal plain and the northwest coastal plain, where droughts are common.

Overall precipitation is usually greater from May through November, although the rainfall is fairly well distributed on a monthly basis throughout the year, with no sharply defined rainy season. The annual rainfall averages 71 in. over the island's 3,300 sq miles and amounts to 12.5 million acre-ft. This is equivalent to 41% of the storage capacity of Lake Mead on the Colorado River, the world's largest reservoir. Annual precipitation varies from more than 200 in. in the tropical rain forest of El Junque to less than 25 in. in the extreme southwest coastal belt.

Puerto Rico is approximately rectangular in shape, with its longer dimension running due east and west. It is 100 miles long and 30 miles wide. The basic drainage pattern is established by a mountain range extending the length of the island. The range averages 2,500 ft in elevation and the highest peak, in the west central portion of the divide, rises 4,490 ft. Two-thirds of the total land area lies north of the crest of the divide and receives about 85% of the rainfall, while the agricultural areas on the north and south coastal plains are nearly equal in size.

The north slopes are relatively long and gradual while the south slopes are short and abrupt. On each side of the divide there are several storage reservoirs. Transmountain diversions by means of tunnels serve to carry water from some of the reservoirs on the north to provide supplemental water for irrigating the rich lands on the south.

Only small areas have been left in forest or planted to other permanent tree growth, so that there is little protection for the watersheds. Nearly all the land area is put to productive use, which requires tilling of the soil and its resultant exposure to washing by the rains. Less than 2.5% of Puerto Rico's total land area is in more or less permanent forest.

Sanitary facilities are noticeably lacking in Puerto Rico. In the rural areas, where 70% of the population live, it is estimated that less than half the families have privies or other satisfactory means for sewage disposal.

MATURED SUGAR CANE, WITH LIMESTONE "TENT HILLS" BEYOND

As a result the island's watersheds are so intensely polluted that water from only a few sources is safe for domestic use without treatment. An important step in providing water safe for domestic use is the reduction or elimination of sources of pollution.

ELECTRIC SILT DREDGE ON GUAYABAL RESERVOIR, IN WHICH 4,000 ACRE-FT OF SILT HAS BEEN DEPOSITED IN 25 YEARS

The urban areas also contribute to the pollution of the island's waters. In 33 municipalities, representing a total urban population of 85,000 people, there are no public sewerage facilities whatsoever. Of the 44 remaining municipalities, 10 have sewage collection systems that discharge effluent untreated into rivers or into the sea, and 34 have systems that discharge into treatment plants before final disposal into rivers. However, the adequacy of even this treatment is very doubtful.

A program of public works for bringing the island's urban sewage disposal systems up to adequate standards has been developed by the Insular Bureau of Sanitary Engineering as part of a larger "public-works-for-health" program. The objective of this overall program is to induce a general lowering of Puerto Rico's high death rates, particularly in the non-degenerative diseases such as diarrhea and enteritis, tuberculosis, pneumonia, and malaria, which are caused largely by insanitary conditions. The program for improving the existing sewerage systems and constructing new ones involves expenditures totaling 3.25 million dollars.

Industrial wastes from the island's 40 sugar refineries further intensify the pollution of the surface waters. These wastes include scum, ashes, solutions of caustic soda, and wash waters and excess molasses. There is a very offensive waste known as "mosto" from sugar refineries operating distilleries for the manufacture of alcohol. These wastes are generally discharged into rivers without treatment, although this practice is in violation of insular law.

A SERIOUS HEALTH PROBLEM

Puerto Rico's highest mortality rate is caused by enteric parasitical and bacterial diseases which are largely water borne (diarrhea, dysentery, enteritis, typhoid, hookworm, and bilharzia). Of the island's people, 70% consume untreated water, 20% consume inadequately treated water, and only 10% consume water that is bacteriologically safe. The provision of ample supplies of pure water for domestic use has been described as Puerto Rico's No. 1 public health problem. Public Health authorities contend that continual consumption of polluted water weakens the human system so that it falls easy prey to many diseases in addition to those that are water borne.

Water from streams or from holes scooped out in the ground is generally used for domestic purposes in rural areas. There are also a few wells scattered throughout these areas to which the people have access. But even well water, while generally potable, is unsafe for human consumption without chlorination.

Modern rapid sand filtration plants serve 463,0 people in thirteen municipalities. The remaining mu cipalities treat their water either by chlorination or n at all. In 1943 the San Juan plant was the only one th produced effluent which consistently met the bacter logical requirements of the U.S. Public Health Serv for drinking water. The poor island-wide showing attributed in many instances to inadequate chemi treatment of the water, and in others merely to impro operation of the equipment. For example, 100% of t samples of water taken during 1941–1942 in three tow whose supplies were supposed to be chlorinated show the presence of B. coli.

In order to provide water of a better quality to t people in the rural areas, a program for the developme of additional wells and springs throughout the isla has been proposed. This program involves an expen ture of 8.43 million dollars to develop 43,000 wells a springs. To bring the urban water supply facilities to adequate standards would cost 7.7 million dolla With its year-round delightful climate, Puerto Rico co be a tropical paradise if high standards of sanitation pr vailed.

IRRIGATION INTRODUCED A HUNDRED YEARS AGO

Some of the richest agricultural lands in Puerto Ri are located on the plains along the south coast and on t northwest coast. These areas have less rainfall than a other parts of the island, the average being between and 55 in. annually. To almost any farmer in t United States this would appear ample for agricultur purposes. However, the amount of rainfall that is e fective in these areas is small because showers are ge erally frequent and of light intensity, with a high run-o rate and a high evaporation rate—about 72 in. annuall Moreover, droughts lasting eight or more months ha recurred on the south coast, and droughts of short duration are common on the northwest coast. Becau of these conditions, irrigation was introduced into Puer Rico by the Spanish farmers over a hundred years ago.

Early methods of irrigation consisted merely of diver ing the rivers into canals, where the latter could be co structed easily. In the year 1908, the need for a wel organized irrigation district on the south coast becam evident. In that year the legislature, at the request o the landowners, approved a law providing for the co struction of the first public irrigation system. A secon public system was later constructed on the extrem northwest corner of the island. Since their inceptio these two districts have undergone various change both in extent of lands included and in management.

There is a paucity of information concerning the dur of water in Puerto Rico. Sugar cane is the princip crop of the coastal plains and the only crop that is i rigated to any extent. Generally 4 acre-ft per year irrigation water in addition to rainfall is adequat Some areas on the south coast, where the soils are ve permeable, require as much as 16 acre-ft of irrigati water annually. In areas where the annual rainf exceeds 60 in., irrigation is not generally needed, althou a few farmers on the north coast, where the rainf does exceed this amount, have increased their cane yiel with irrigation.

Today the south coastal irrigation district is under th administration of the Puerto Rico Water Resourc Authority, a public corporation of the insular governme The northwest district is under the administration of th Isabela Irrigation Service, a division of the Departme of Interior of the Government of Puerto Rico. Tot lands irrigated in 1940 amounted to 78,210 acres.

there about 36,000 acres are in the south coastal irrigation district and 10,000 acres are in the Isabela Irrigation District (Fig. 1). About 28,000 additional acres could be brought under irrigation.

HYDROELECTRIC POWER

Wherever feasible, the irrigation districts have developed hydroelectric power in connection with their control structures. Except for the hydroelectric power developed by the Isabela Irrigation Service and marketed in the northwest section of the island, the Water Resources Authority owns, operates, and controls all the hydroelectric and all the public utility steam-electric generating plants. Government ownership and control of two privately owned utilities, the Mayaguez Light, Power, and Ice Company, and the Puerto Rico Railway Light and Power Company, was effected when the Water Resources Authority purchased them on December 11, 1943, and January 14, 1944, respectively, for a total consideration of $11,700,000.

With the entire power grid under government management, hydroelectric power can be utilized to its fullest advantage, it being necessary to resort to steam only when the maximum hydroelectric production is exceeded by the demand. It is to the island's disadvantage to import oil for power, as goods and services which are scarce on the island would have to be exported in exchange. The costs of generating steam-electric power and hydroelectric power cannot be directly compared, since a great deal of federal money has gone into the latter and is not reflected in production costs.

During the fiscal year ended June 30, 1942, an average of about 20,000 hp of hydroelectric energy was available 90% of the time. Present production could be tripled. It has been estimated that all the feasible hydroelectric developments would make available 72,000 hp for 90% of the time, and 174,000 hp for 50% of the time. A more conservative estimate places the total hydroelectric power generating capacity feasible of development at not more than 64,000 hp available 90% of the time.

With certain exceptions, the needs of irrigation rather than those of power determine the amount and rate of water to be released from storage reservoirs in Puerto Rico (Fig. 1). Because the rainfall is fairly well distributed throughout the year and releases for irrigation are continuous throughout the year, the island is

COMERÍO RESERVOIR DEVELOPS 23 MILLION KWHR YEARLY IN TWO POWER PLANTS

uniquely assured of fairly continuous flows in the vicinity of hydroelectric sites. Thus, uniform annual distribution of power is possible.

Production of electricity has shown a steady growth. It has increased from nearly 78 million kwhr in 1933–1934 to over 253 million kwhr in 1942–1943, an average increase of 19.5 million kwhr yearly. In recent years (with the exception of the year 1942–1943), the amount of electric energy generated by steam power has increased more rapidly than the amount generated by water power. The reason is that the development of hydroelectric projects has not been able to keep pace with the demand for energy, and the additional burden has been thrown onto the steam standby plants. During 1942–1943, the amount of hydroelectric energy generated was nearly 187 million kwhr and the amount of steam energy was nearly 67 million kwhr.

Existing hydroelectric power installations total 59,000 kva, while plans for proposed new units call for additional generating capacity in excess of 67,000 kva. The generating capacity of present commercial steam-electric plants totals about 32,000 kva. Installed generating capacities at hydroelectric plants vary from as little as 450 kva to a maximum of 10,800. The largest plant planned for the future will have an installed capacity of 22,500 kva.

The economic feasibility of installing large wind-turbine electric generators in Puerto Rico has not yet been fully explored, although it has been under consideration for some time. The potentialities of the island's continuous trade winds appear to make the outlook promising for the development of electric energy from this inexhaustible source. The annual average hourly wind velocity is 11.3 miles per hr. The maximum monthly average is 12.9, and the minimum monthly average, 8.7 miles per hr. The prevailing winds are

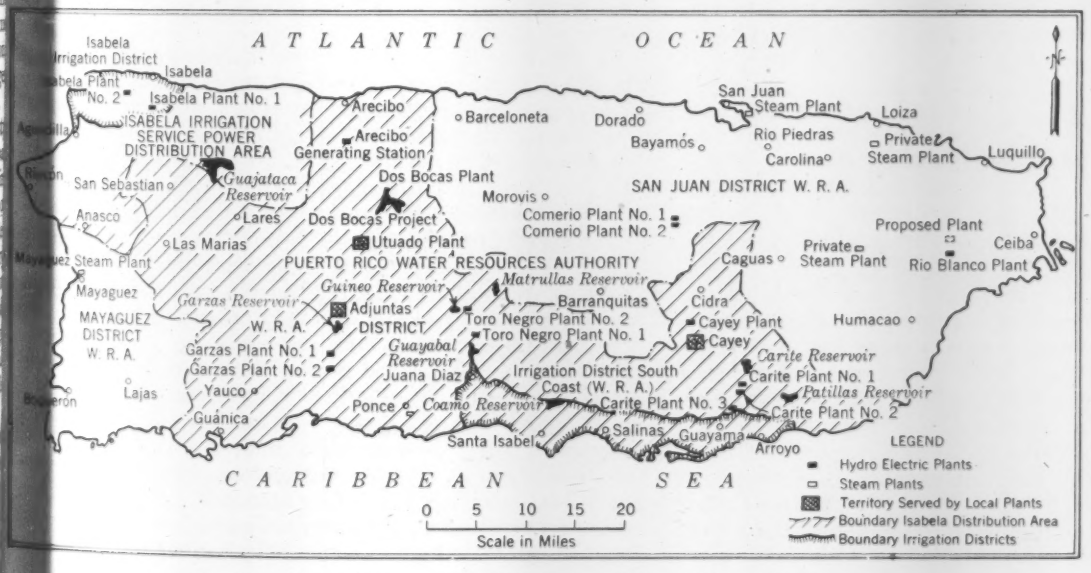

FIG. 1. POWER PROJECTS AND IRRIGATION DISTRICTS OF PUERTO RICO

Afterbay in Foreground; Power House, Penstock, and Workers Cottages in Background

Power Plant in Foreground, Afterbay and Canal to Plant No. 1 in Background

GARZAS HYDROELECTRIC PLANT NO. 1 (9,000 KVA) USES WATER FROM GARZAS RESERVOIR ON NORTH SIDE OF ISLAND, DIVERTED THROUGH 11,700-FT. TUNNEL

from the east. The mountain divide is roughly parallel with the direction of the winds, thus affording many potential sites throughout the island.

For years Puerto Rico has been wasting power that could have been put to productive use. In the island's forty sugar refineries, which are rather uniformly distributed throughout the coastal plains, large amounts of steam are required in the processing of sugar-cane juice. The refineries also use steam to generate electric energy for operating mechanical equipment to extract the juice from the cane. The fuel used for generating steam is bagasse, the sugar-cane fiber from which the juice has been extracted. It has been estimated that not more than 80% of the bagasse produced is needed to meet the power requirements of the refineries. The remaining 20% is burned merely to get rid of it. Power from this 20% could be extracted for productive uses.

The value of bagasse as a fuel may be indicated by the following observations. As fired into furnaces at the refineries, moist bagasse has about 3,880 Btu per lb net available for the boiler. Fuel oil has 158,600 Btu per gal. On this basis a ton of bagasse is equivalent to 49 gal of fuel oil. Sugar cane yields about 495 lb of bagasse per ton, including moisture content. In an average year, Puerto Rico produces 6,368,871 tons of sugar cane, the bagasse derivative of which is equivalent to 77 million gal of fuel oil in terms of heating value. If 20% of this were made available in the form of electric energy, it would amount to over 100 million kwhr, assuming a thermal efficiency of 15%. This is nearly 40% of the total amount of electric energy generated by all public utility companies in Puerto Rico during the years 1942–1943. Only a small fraction of it is now being used.

The total installed electric generating capacity of the sugar refineries is 53,000 kva, equivalent to 59% of the public utility generating capacity. A few of the refineries have their power units interconnected with the insular power grid, permitting exchange of electric energy. In 1942–1943 nearly 4 million kwhr were sold by the refineries. During the sugar-cane grinding season, power is sold by the refineries, while during the non-grinding season power may be purchased by the mills for the pumping of irrigation water and other purposes.

As a means of more efficiently generating power at the mills and of utilizing power from the bagasse that is now going to waste, the following recommendations have been made: Replace low-pressure steam units with more efficient high-pressure boilers and operate all steam power and processing units efficiently; install efficient high-pressure bleeding turbines which may also be operated condensing; and interconnect more of the power units with the insular power grid for exchange of power.

In countries having no petroleum resources of their own, local sources of other high-energy liquid fuels assume a relatively greater importance than elsewhere. While Puerto Rico has no known exploitable oil resources there are excellent potentialities for the manufacture of ethyl alcohol, which has been successfully used as a motor fuel in the Philippines and in other countries.

In an average year, 33 million gal of molasses of about 52% sugar content are produced as a by-product in the manufacture of raw sugar from cane. One gallon of 190-proof ethyl alcohol can be derived from 2.5 gal of molasses. Thus, about 13.2 million gal of alcohol could be produced annually, more than double the present yearly production of 6 million gal. Experience in Puerto Rico has shown that $\frac{1}{2}$ gal of fuel oil or its equivalent is required in the production of one gallon of alcohol. This suggests another use for excess bagasse.

Whether or not it will become economical to use alcohol as a fuel for motor vehicles in Puerto Rico depends upon the ability of alcohol manufacturers to compete with the producers of other motor fuels.

INDUSTRIAL USES OF POWER

In 1942 the legislature of Puerto Rico created and set up the Puerto Rico Development Company and an accompanying bank designed to do, in the insular government, much the same sort of thing that the Reconstruction Finance Corporation does in our Federal Government. These institutions are able to encourage enterprises or to start them and so lead the way to new economic opportunities.

The first tangible results of Puerto Rico's industrial program include an industrial alcohol plant, a cocoanut fiber bag-making plant, a cement plant, and a bamboo furniture industry, all financed exclusively with private capital. Additional industries that may be developed in the near future include a paperboard mill utilizing waste paper and bagasse; a wallboard mill utilizing bagasse; a cotton weaving and finishing plant; and a food-yeast plant. At present a glass plant with a capacity of 100 tons daily is being constructed. To continue to expand its industrial program and to bring to Puerto Rico resources which it now lacks are the hopes of the Development Company.

Sediment Complicates Flood Control

Soil Conservation, an Essential Part of an Effective Control Program

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CURRENTLY interest has been directed toward river-control and water-utilization projects on a regional scale. Flood control, power development, navigation—and conservation of soil and water—are all a part of such a program. The cumulative effect of sedimentation on all these beneficial objectives is eventually to destroy their usefulness. In dollars, the annual damage from sediment now reaches well over 50 millions, according to Mr. Brown. The time has come, he explains, when this problem can no longer be handled by rule-of-thumb methods.

LESS than a generation ago the concept of flood control seldom went beyond the protection of specific localities against inundation. Today flood control is widely recognized as an integral part of the much broader and more complex problem of multi-purpose watershed development. It has become one of the benefits that must be achieved together with, but not to the exclusion of power development, irrigation, water supply, waterway improvement, increased agricultural production on fertile bottom lands, soil and water conservation, recreation, and preservation of wild life.

The far-reaching effects of sediment have been often overlooked in past flood-control and watershed planning. In the surveys made by the U.S. Department of Agriculture under the Flood Control Act of 1936, sediment has been considered an integral part of the flood problem on the grounds that it is entrained, transported, and deposited largely by flood flows or during flood-producing storms. It modifies the characteristics of flood flows and the damages they produce. Its effect on all types of flood-control works must be considered, and the effects of various flood-control measures in the prevention of sediment damages must be evaluated. The following types of sediment and related flood-water erosional damages were evaluated in one or more of the Department's surveys.

Cultural damages result from sediment deposited on streets, in houses, machinery, sewer lines, and other places from which it must be removed before the facility can be used again. For example, after the flood of March 17, 1936, at Johnstown, Pa., approximately 4,000,000 cu yd of sediment and debris were removed from streets and cellars at a cost of $3,870,000, largely by hand work.

RECURRENT SEDIMENT DAMAGES TO LAND

Damage to crops from flood water depends on the type of crop and the duration of inundation. Some crops can be inundated by clear water for a few hours to a day or more without material damage, but a film of silt left as a coating on the plants almost invariably causes a total crop loss. In the Turkey River watershed, Iowa, where the average annual agricultural damage is estimated to be $2,500, frequent spring and early summer floods of short duration and small volume resulting from severe thunderstorms occur when the surface soil is loose from recent cultivation. Overflows carry high silt loads and cause severe to total damage to bottom-land crops in an early stage of growth, although the same volume of sediment-free water would cause only minor damage.

RECURRENT DAMAGE IN WATER UTILIZATION

Cost of water filtration for domestic and industrial uses is seldom included in appraisals of flood damage, although the high concentrations of sediment occur at flood stage, and large savings would result from lowered costs of treatment if sediment were reduced in amount by deposition in upstream flood-control reservoirs, or through soil conservation. In the Soil Conservation Service's economic study of water filtration in 22 North Carolina Piedmont cities, it was found that the average cost of water treatment, including overhead and amortization of plant and equipment, was $70 per million gal, of which $27 was the cost of the treatment alone, and $5 was the cost of chemicals—primarily alum used for flocculation.

The study showed that a 30% reduction in the suspended load of the streams, a modest expectation from an adequate conservation program in this region, would result in an average immediate saving of $1.50 per million gal. It was estimated that future savings from smaller capital outlay for new settling basins and plant equipment, reduced flushing costs and other plant

INFERTILE SAND DEPOSITED ON CROP LAND BORDERING THE OHIO RIVER DURING FLOOD OF JANUARY 1937

operations, would eventually bring the total savings to $7 per million gal, or $94,500 annually for the 22 cities. For the United States as a whole it is estimated that 32,000,000 persons are served with treated surface water from which sediment has been removed. The amount so treated is approximately 1,400 billion gal per year. A saving of only $1.00 per million gal treated would represent an annual benefit of $1,400,000.

Recreational losses and damage to wild life are widely recognized by sportsmen. A good angler knows that

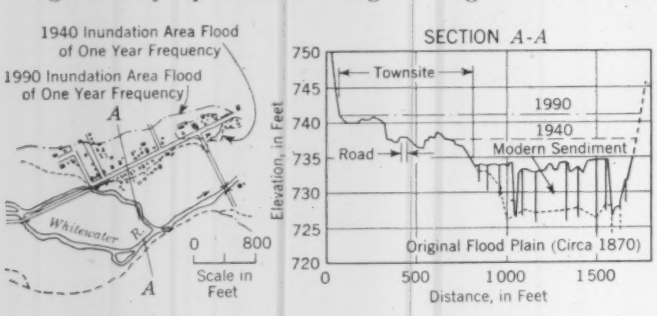


FIG. 1. ESTIMATED FUTURE INCREASE IN AREA OF INUNDATION RESULTING FROM SEDIMENTATION IN WHITEWATER RIVER VALLEY AT ELBA, MINN.

game fish will not bite when the water is muddy. Nor does he fish when streams are in flood. In the Department of Agriculture's preliminary flood-control examination of the Meramec River watershed Missouri, it was found that stream flow above the mean during the recreational season (May 15–September 30) carries enough silt to interfere with fishing and swimming.

Counts by the Missouri State Planning Board in 1940 showed that 834,350 persons used this watershed for recreation. The expenditure per person per day was valued conservatively at $1.00 above the normal cost of living. Silty water was found to reduce the recreational attendance an average of 33⅓% and overbank flood stage 80%. The estimated average number of days of silty water during the season is 23 to 29, and of flood stage 1 to 4. After making allowance for non-attendance during an average of 5 days of rain, and for deferred recreation, the loss in recreational person-days due to floods was estimated at 11,685 and that due to silty water at 49,090, which represents an annual monetary loss of $60,775. Similar methods of evaluation could be applied to any watershed.

CUMULATIVE LAND DAMAGE

A large part of the sediment and associated erosional damage resulting from flood flows is fundamentally different from flood-water damage in that it is a cumulative damage to the land. Whereas flood-water damage can be correlated with stage, duration, frequency, and season of flood flows, and its recurrence interval can be computed by available hydrologic techniques, sediment damage is progressive and can be evaluated only with respect to the average rate of development.

This difference can be simply illustrated. A crop may be ruined by flood water this year, but an equally good crop can be grown the following season, in the absence of a flood. The damage is measured by the loss of income from the sale of the crop. On the other hand, partial to complete loss of land productivity by deposition of infertile sediment or flood erosion represents an impairment in capital value. This loss affects all future production. It is probably best evaluated as the present worth of all future net returns from the crops that might have been grown with unchanged conditions, less the return from the crops that can be grown, if any. An alternative method of evaluation would be to use the cost of sediment removal or soil rebuilding if that is smaller. In high-value California citrus orchards, $4 or more per acre has been spent to remove flood-deposited sand. Studies by the Soil Conservation Service (U. S. D. A. Technical Bulletin 695, 1940) have shown that conditions in most valleys, especially the smaller ones, were rather stable prior to deforestation and cultivation that changes due to stream meandering and overbank flow took place slowly. In hundreds of valleys the old topsoils are buried by rapidly accumulated and often less fertile "modern" sediment. (See an accompanying photograph.) The validity of this dating has been frequently confirmed by fence posts, coal, mine waste, bricks, and other artifacts buried in the "modern" sediment but never below the dark topsoils.

In the Kickapoo River watershed, Wis., sedimentation measurements showed an average channel and flood-bottom aggradation of about 1 ft in 20 years for an average period of 90 years or less since the beginning of cultivation. Comparison of existing and reconstructed original profiles across the main valley from Ontario to the mouth of the river indicates an average rise in flood heights to date of 2.5 ft for the same discharge. Continuation of this trend for 20 years will cause an increase of about 40% in damage to seven urban areas built on low terraces adjacent to the present flood plain. The annual urban flood damage will be raised from $38,2 in 1938 to an estimated $53,337 in 1958. Similar conditions have been found on numerous streams in the Upper Mississippi Valley region. An illustration from the Whitewater River, Minnesota, is shown in Fig. The comparative importance of land damage in representative watersheds, as evaluated by the Department of Agriculture surveys, is shown in Table I.

Not all flood-plain sedimentation is harmful. The high productivity of many flood plains has been maintained—in the classic case of the Nile for at least 5,0

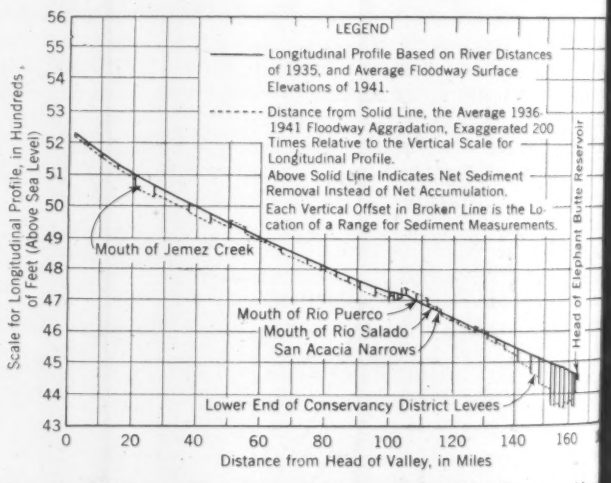

LEGEND
Longitudinal Profile Based on River Distances of 1935, and Average Floodway Surface Elevations of 1941.
Distance from Solid Line, the Average 1936-1941 Floodway Aggradation, Exaggerated 200 Times Relative to the Vertical Scale for Longitudinal Profile.
Above Solid Line Indicates Net Sediment Removal Instead of Net Accumulation.
Each Vertical Offset in Broken Line is the Location of a Range for Sediment Measurements.
Mouth of Jemez Creek
Mouth of Rio Puerco
Mouth of Rio Salado
San Acacia Narrows
Lower End of Conservancy District Levees
Head of Elephant Butte Reservoir
Scale for Longitudinal Profile, in Hundreds of Feet (Above Sea Level)
56 55 54 53 52 51 50 49 48 47 46 45 44 43
0 20 40 60 80 100 120 140 160
Distance from Head of Valley, in Miles

FIG. 2. FLOODWAY AGGRADATION ON THE RIO GRANDE ABOVE ELEPHANT BUTTE RESERVOIR FROM 1936 TO 1941

years—by regular thin deposits of fertile silt and clay. Harmful deposition is primarily a result of encroachment of accelerated soil erosion into infertile subsoils, and of increasing loads of coarse material, coming particularly from gullies and eroded stream banks. Benefits from deposition, where they exist, should be recognized and evaluated as an offset against any flood-control work that will greatly diminish or eliminate this supply.

One of the most significant findings in the Department of Agriculture surveys has been the widespread exte

to which the flood-carrying capacity of natural channels and adjacent first-bottom floodways has been reduced by sedimentation. Almost without exception, past flood-frequency studies have been based on assumed constant channel capacity. Actually, in many watersheds, particularly on the headwater tributaries, channels and first-bottom floodways are being progressively reduced in cross-sectional area so that future flood flows of the same volume and duration will cause a higher stage and greater area of inundation with corresponding increase in the rate of damage (Fig. 1).

This is all the more significant because the Department's surveys indicate that about 75% of all flood damages occur on headwater tributaries generally above the protection of major flood-control reservoirs and levee systems. These damages are largely agricultural and result mainly from the more frequent small to moderate-size floods. Actually, the much more spectacular damages from major floods to urban areas account for only about 15%, and damages on main-stem and principal-tributary flood plains are only 10% of all flood damages.

Careful investigation is needed to determine whether channel aggradation is primarily a local or a general phenomenon. Local clogging of channels often results from backfilling of sediment behind fallen trees or other obstructions. The streams would be capable of carrying through the sediment load delivered to them if such obstructions were periodically removed. The extent to which over-bank flow and flood damages might be thus decreased should be known before other more expensive methods of flood control are justified on the basis of present average damages. On the other hand, in many watersheds the present rate of coarse-sediment production exceeds the stream's capacity to deliver the load to its mouth, and general aggradation is resulting. Channel rectification to increase discharge and load-carrying capacity, upstream reservoirs or debris barriers and soil-erosion control to decrease sediment supply, are applicable methods of control. The effect of such large dams as Elephant Butte and Boulder in causing channel deepening by shutting off the sediment supply, is well known.

The actual bulking of flood flows by sediment in some western streams increases the area and extent of damage. Bulking to the extent of 5% to 15% on the Rio Grande, Colorado, and other major streams is not uncommon. In the small, steep mountain watersheds above Los Angeles, Calif., flood flows caught in debris basins have proved to be 85% solids by volume (after settlement) and only 15% free water (above the amount required to saturate the deposit).

In some areas sedimentation is increasing the channel discharge capacity by aggrading the flood plain, but not the channel. Where the load is largely fine and carried in suspension, the flood-plain surface may be raised several feet while the channel bed remains constant.

EROSION OF FERTILE ALLUVIAL SOIL BORDERING OHIO RIVER DURING FLOOD OF JANUARY 1937

CUMULATIVE DAMAGE TO WATER UTILIZATION

Silting of storage reservoirs has been widely publicized in recent years. Adequate techniques have been developed for measuring the extent and distribution of such sedimentation. Wide divergence of opinion exists, however, on the proper monetary evaluation of storage losses. Various methods involving depreciation of investment, future cost of replacement, and progressive loss in service value have been used. None of the methods thus far applied, in the writer's opinion, adequately accounts for the loss of value inherent in the reservoir site or the social structure dependent upon it. Sites are limited and irreplaceable natural resources, and the value of their loss cannot be adequately measured by the same yardstick used to amortize a factory or determine the depreciation of machinery. Here is a fertile field for economic research.

In 30 Department surveys embracing 379,785 sq miles, or 12½% of the area of the continental United States, the aggregate annual damage from reservoir silting was evaluated at $1,476,515. If the damage were proportional on the basis of area, the total for the United States would be $11,812,000. Many large reservoirs suffering heavy damage, such as Lake Mead, are not included in this group of watersheds. Adequately evaluated, the total damage to the Nation's 8,900 larger reservoirs may be as high as $50,000,000 annually, or 1% of the investment of nearly 5 billion dollars in dams and reservoir lands.

TABLE I. COMPARISON OF LAND DAMAGE AND CROP DAMAGE

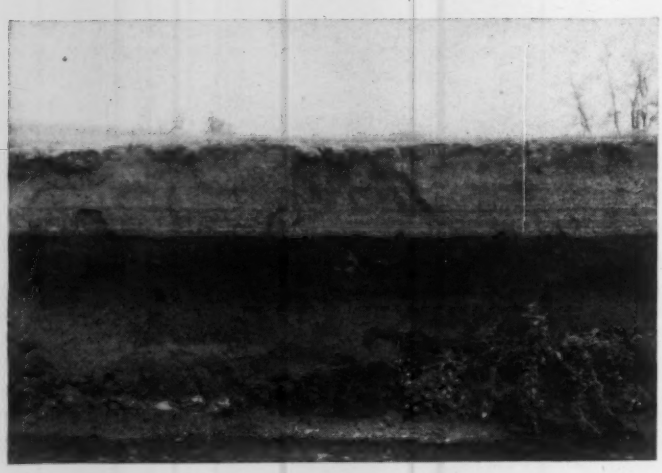
WATERSHED	DRAINAGE AREA, SQ MILES	AVERAGE ANNUAL LAND DAMAGE,* DOLLARS	AVERAGE ANNUAL CROP DAMAGE, DOLLARS
Muskingum River, Ohio	8,038	115,000	216,000
Washita River, Okla.	8,108	5,918	1,952,343
Little Tallahatchie River, Miss.	1,355	591,023	342,973
Upper St. Francis River, Mo.	1,310	8,023	11,093
Meramec River, Mo.	4,000	49,075	109,000
Turkey River, Iowa	1,696	17,500	58,000

* Exclusive of bank erosion.

Silting of harbors and navigable waterways is a major problem that has not been generally or adequately evaluated in connection with flood-control surveys. An estimated $3,200,000,000 has been spent in the United States on waterway improvements, exclusive of terminal facilities. It is estimated that the annual cost of maintenance of harbors and inland waterways resulting solely from deposition of sediment caused by upland soil erosion and stream-channel erosion, but excluding the effects of tidal currents, is $11,000,000. For example, in the past 100 years the U.S. Army Engineers have moved more than 111,000,000 cu yd of sediment in the Baltimore, Md., harbor and its approaches at a cost of

nearly $17,000,000. A large sum, in addition, has been spent by the city and private interests. The current expenditure for maintenance dredging of this harbor is about $150,000 annually. The yearly sediment inflow to the harbor is estimated to be approximately 600,000 cu yd.

The initial public cost and 25-year maintenance for a complete soil-conservation program on the 584-sq mile drainage area above the Baltimore harbor is estimated to be $750,000. More than 90% of the sediment load that reaches the harbor from this area is estimated to come directly from upland slopes as a result of accelerated soil erosion. An adequate soil-conservation pro-



DEPOSIT OF 30 IN. OF MODERN SEDIMENT OVERLYING OLD BLACK SOIL IN GALENA RIVER WATERSHED, WIS.

gram in this area should reduce the sediment inflow 75%. On the basis of reduced dredging costs alone, not considering the large benefits to farmers and others, such a program would pay for itself in 12 years after completion, and in 25 years would save the government $750,000 over and above all costs.

Silting of drainage and irrigation canals, of fish spawning grounds and oyster beds, has long been recognized by those concerned with problems of their maintenance. A large part of the $1,000,000 annual cost of maintaining open drainage ditches is a result of sediment deposition. Several million dollars of the $43,000,000 annual cost of maintenance and operation of irrigation enterprises may also be charged to sediment removal from irrigation canals. Watershed developments associated with flood control such as multi-purpose reservoirs, debris basins, and soil conservation, affect the supply and delivery of sediment to these enterprises, and their interrelation should be evaluated in all major watershed projects.

EFFECT OF SEDIMENT ON FLOOD-CONTROL WORKS

Effects of sediment on flood-control and multi-purpose reservoirs clearly need to be better understood in view of the prospective spending of another billion dollars for new construction in this field in the early postwar period. Flood-control reservoirs are ordinarily designed to impound all flow above bank stage of floods having a certain estimated recurrence interval. Any reduction by sedimentation in the flood-water storage space means that the dam can control to an equal degree only a flood having a smaller recurrence interval than that for which it was designed. If a project was determined to be economically justified to control a 100-year flood, then a reduction in its efficiency to the point where it will control only a 75-year flood creates a damage that may be measured in terms of a reduction in the compute benefits of the project as designed.

Flood-control storage in the upper 10, 20 or 50 ft multi-purpose reservoirs is ordinarily lost very slow until the storage at lower levels in the power, irrigatio or water conservation pools is greatly depleted. It shou be anticipated, however, that as the large multi-purpo reservoirs lose capacity, the revenue-producing power irrigation storage will be maintained by reducing t storage allotment for flood control, unless alternati storage is provided. The cost of this alternative storag can be also evaluated as a sedimentation damage.

Sedimentation in improved channels and leveed floodway is particularly insidious because people assume a consta degree of protection from them which may, in fact, gradually decreasing. Improved channels and restricte floodways theoretically increase sediment transport b increasing the velocity of flood flows. This increase ma not be sufficient, however, to overcome the excessive lo delivered to the floodway. Furthermore, confinement flow by levees may prevent unloading which the strea formerly accomplished while moving in slow, shallow over-bank flow across a broad flood plain. The co centration may be thus increased within the floodwa to the point where progressive accumulation results.

Throughout the Middle Rio Grande Valley, Ne Mexico, the river is confined by levees except for a stretc about 14 miles long above the original head of Elepha Butte Reservoir. Soil Conservation Service survey have shown that the average annual accumulation sediment in the floodway during the 5 years 1936–194 was 3,312 acre-ft. This is equivalent to an averag aggradation of about 1 ft in 12 years. The accumula tion in the entire valley both within and outside th levees was 12,000 acre-ft per year. Sedimentation ha been quite irregular, some sections being degraded an others aggraded more heavily. (See Fig. 2.) Presen data are not sufficient to relate the rate of aggradatio quantitatively to the rate of frequency of overtoppin of the levees, but the increasing flood hazard is obvious

MORE RESEARCH NEEDED

Too few quantitative data have been obtained, o at least published, on sedimentation and scour with the great levee systems of the Mississippi and its majo tributaries, the Missouri, Arkansas, Red, Yazoo, an others. A comprehensive system of cross-section ranges from levee to levee should be established on a these major streams, and the results of surveys made a intervals of 1 to 5 years should be promptly published fo appraisal by the engineering profession.

On the basis of current evaluation techniques, th average annual damage from sediment would probabl lie somewhere between 50 and 100 million dollars, bu the import of the problem cannot be measured in thes terms. Continued evasion of the sediment problem made possible mainly by building bigger and bette reservoirs and higher and stronger levees, will ultimatel defeat its own purpose. "Rational" guesses on th scouring action below large dams, the sediment-transport ing capacities of streams, the rate of silting of reservoi and leveed floodways, and other sediment dynamic are not only costing large sums today for needless o unwarranted construction, but are adding up a staggering bill for future repairs if, indeed, repairs can be made Certainly many of these costs could be saved by relatively small appropriations today for needed research and field measurements and for the application of known principles to the control of sediment closer to its point of origin.

Engineers' Odyssey to Europe—1889

II. England and Wales in Springtime

A Tour, Personally Conducted—in Memory—by Four Society Members

By A. Prescott Folwell, James B. French, Andrew J. Provost, Jr., *and* T. Kennard Thomson

A NOTABLE transatlantic excursion was enjoyed by a large party of American engineers in the spring and summer of 1889. A previous article described the background of this historic visit and the trip itself—as far as Liverpool. Shortly there intervened a long week-end during which, because of its religious significance, official festivities ceased. It was during these Whitsuntide Holidays that a number of individual excursions were arranged for the Americans. Recollections of these tours are here recounted by four civil engineers, not now young but possessed of a vivid memory of these events. These four are the only ones of the Society party now alive. Later articles will carry the story to London, to the Paris Exposition, and to other places on the Continent.

FRENCH: As Thursday, June 6, the date of arrival of the American engineers at Liverpool, came just before the Whitsuntide Holidays so widely observed in England, and since The Institution of Civil Engineers had prepared an elaborate program for their entertainment in London starting on June 13, just a week later, six intermediate "tours" were arranged to occupy the interval of the Whitsuntide recess."

PROVOST: On that Sunday afternoon, Folwell and I went to Chester, having decided to approach London by way of Warwickshire and the Midlands. Chester, close to the border of Wales, and erected on the site of a Roman military camp, we found most interesting. The old Roman wall and its stone battlements, where archers once stood to repel a besieging enemy, seemed particularly well preserved.

FOLWELL: Practically the entire party walked around the top of this old Roman wall, which completely surrounds the ancient part of the city. Just outside the city, crossing the river Dee between the racecourse and Curzon Park, was a stone arch bridge of 200-ft span, said to be the longest in Great Britain. The use of red and white sandstone in its construction produced a striking effect.

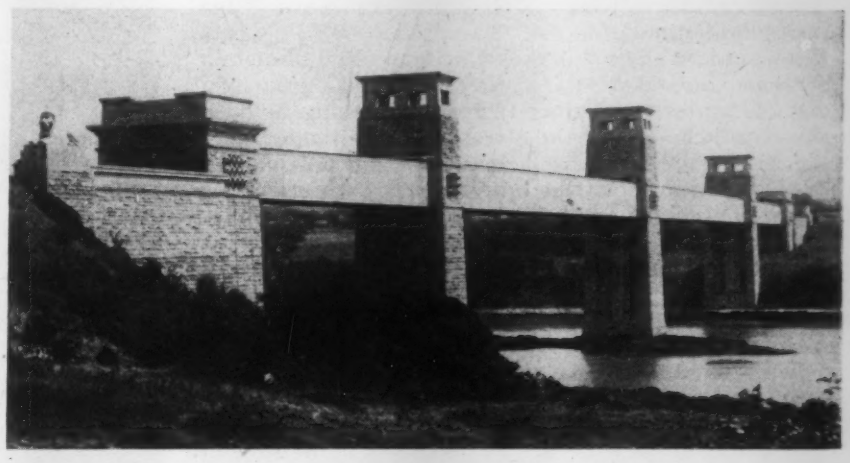
PROVOST: The buildings that line the streets of Chester are old and have their upper stories extended to form arcades over the sidewalks. The most noted residence is God's Providence House, said to be the only house spared a visitation of the plague in a remote period. The Cathedral is fine gothic, and my interest in it increased in later years when I learned that its interior had been restored before our visit by my close friend and golfing companion, Mr. Nathaniel Vickers, now for many years a resident of New York, and still (1944) an active golfer in his ninety-eighth year.

When Folwell and I went for a walk on the Roman wall, we encountered a diminutive old Cockney who proceeded to sing for us in a piping, squeaking voice a ballad about the Miller of Dee. His effort, at least, deserved the shilling we gave him. A short distance out of Chester was Eton Hall, one of the many elaborate mansions owned, and at times occupied, by the Duke of Westminster, then rated as the richest of the English dukes. We walked out hoping to see the place. The gate attendant had not, it seemed, ever heard of the visit of the American engineers, or of the courtesies they had rather come to expect. All that we saw looking through the iron bars of the gates was a portion of the park.

FOLWELL: We chose to go from Liverpool to London through the "Shakespeare Country," buying a railroad ticket which permitted as many stopovers as we wished; and we stopped, at least over one train, at nearly every station on the line. We may not have seen all the objects of historic interest that guides would have led us to, but we learned a lot more about the people and had interesting adventures—such as that which befell us in Chester.

On entering an old inn there one evening we found ourselves facing a long room with seats lined up around the walls, and all occupied except three, which were located on a platform raised about 8 in. above the floor, in the middle of the wall facing the door. Somewhat embarrassed, we seated ourselves in two of these. Asking the nearest Englishman why there were broad smiles on all faces, we were told that this was a sort of club and the custom was for late comers who had to take these seats to treat all present, but that it would not be expected of us as we were visitors to the city. Later we learned that this was King's Arms Kitchen, the meeting place of a mimic corporation, said to have been established by Charles I, and the elevated chairs were provided for the "Mayor" and other officials of the corporation.

PROVOST: A short drive from Coventry brought us to the ruins of Kenilworth Castle. Here were settings that made us camera conscious. Arguing about position, light, exposure, we climbed and reclimbed the walls until agreement about details was reached, and a number of snapshots taken. Most careful we were to observe that the proper index number of each appeared with due regularity. From that time on, objects of special interest were shot until, before we left London, the index showed the maximum number of exposures completed.



TUBULAR RAILROAD BRIDGE OVER MENAI STRAITS, WALES
Towers Provide for Later Addition of Cables—If Needed

CONWAY CASTLE AND TELFORD'S SUSPENSION BRIDGE HARMONIZE
Tubular Bridge, Also Famous, Is Just Beyond

At Warwick, our next stop, we put up at the Red Lion Inn. The passing of the years seems not to have dimmed the memory of the unusual and delightful features of the place. The building was obviously old, but clean and well kept up. The staff was ample; the service perfect. The barmaids and waitresses in white caps and aprons, the lackey who took charge of the horses of those who arrived by carriage or saddle, the chambermaid, and even "the boots"—all seemed eager to make a guest's stay memorable. The host was genial and attentive. At dinner he presided at a large circular table where sat perhaps a dozen or more guests, and led the conversation, which became general. The roasts were brought in on wheeled carriages. These in turn were halted beside each guest, who carved for himself the piece he preferred. Ale was served in large earthenware mugs. We begrudged the hours wasted at Birmingham, which left us only a single night at the Red Lion.

In the morning, we took time for a brief visit to Warwick Castle, said to be the best preserved of England's private fortresses, having in some way escaped the destruction that the civil wars wrought on so many English structures of the Middle Ages. Some thirty years later, accompanied by my wife, I revisited Warwick. The castle and its park on the river were as I had first seen them, but the charms of the Red Lion Inn, which I had so long extolled, were gone. It had become just a common tavern, noisy, irresponsive, and not too clean. "Sic transit gloria mundi."

FOLWELL: We left Warwick Castle to obtain lunch in the village, and outside the castle walls found a group of a dozen or more of the engineering party standing, helpless looking, in a huddle in the street. One of them, asked where they were going, replied that he did not know—they were waiting for their tour guide to return and tell them, said guide having been gone some time to arrange about their lunch. Where or if they finally ate I do not know, but Provost and I had a most enjoyable lunch at an old inn—the Warwick Arms—and I then resolved never to be a member of a tourist party.

PROVOST: My most vivid memory of Stratford is that we walked out in the evening through fields toward the church housing the famous crypt, and paused beside the Avon atop the only fence I recall seeing in England, to view the moonlit scene. Thereupon a nightingale poured forth his rich song from a nearby tree, the first such music either of us had ever heard.

FRENCH: Our large "tour" left Chester by train in time to reach Llandudno for dinner and we spent Friday night and Saturday morning at this celebrated watering place, then considered the finest and most popular in Wales. The town is located on a beautiful bay with a fine beach, and was equipped with excellent hotels, including the Tudno Castle at which our party was accommodated. Saturday morning was principally spent taking rides in open coaches to nearby points of historical interest, but some of us managed to try out the bathing facilities of the place. With present conditions at American beaches in mind, it seems of interest to record that at that time, at least at Llandudno, men and women were required to use entirely separate portions of the beach. Small bathhouses on wheels served a curious function; they were entered near the edge of the water and were then pulled out by a horse to a position where the bather could step from the bathhouse into the water.

During Saturday afternoon the whole party traveled by tram to Bettws-y-Coed, where we all spent Sunday (June 9). Bettws-y-Coed, or "the Chapel in the Wood," was a delightful little place, within 8 miles of the west base of Snowdon, the highest mountain in England or Wales. The town was described by Baedecker as "perhaps the most popular resort in Wales for artists, anglers and tourists." One of my pleasant memories of that Sunday afternoon is of an enjoyable walk with L. L. Tribus, another young Junior of the Society. We followed a beautifully wooded mountain stream from which we had a view of Snowdon. Incidentally we walked over the old Pont-y-Pair, an arch bridge of dry stone masonry said to have been built in the fifteenth century.

THOMSON: In the evening some Welsh musicians came in and entertained us with their superb singing. The ladies of our party thought that it would be nice to return the compliment by singing "God Save the Queen" (that was 11 years before Queen Victoria died) expecting the Welshmen to join in the singing, but "divil a bit of it would they.

The reason was, and is, that while the English were always able to win the battles, little good it did them, for the Welsh were always ready for another battle. Finally the Welsh agreed that they would accept any man as king of Wales, provided that he had been born in Wales and could not speak a word of English. So King Henry

FIFTEENTH-CENTURY MASTERPIECE, PONT-Y-PAIR BRIDGE, WALES

LLANDUDNO, NOTED SEASIDE RESORT IN NORTH WALES

sent post haste for his wife to come to Wales, where the first Prince of Wales was born. The Welsh lived up to their bargain but never forgave the trick.

FRENCH: On Monday morning we were taken by train to Bleanan Ffestiniog, the site of extensive slate quarries employing thousands of workmen. Here representatives of the principal companies had their workmen demonstrate for us all the various steps in the preparation of the slate for roofing and other purposes. We were then taken down into one of the largest of the mines. These quarries employ thousands of workmen and the slates are shipped to all parts of the world. After the inspection of this mine, we were taken over what they called their "Toy Railroad," which had a gage of only 1 ft 11 in., to Port Maddoc, the seaport from which the slate was shipped. This narrow-gage line was located on high ground overlooking a valley richly green with grass and foliage through which a small stream wandered, making the short 13-mile ride a pleasant memory.

THOMSON: In those days I called myself a bridge engineer (I was 25 years old!) and thought that I ought to combine pleasure with business and study English bridges. But when I saw the bridges over the Menai Straits, and realized that the English were still using cast iron, I knew that they could not at that time teach American bridge engineers much.

Even the great Firth of Forth Bridge was no exception. English engineers of those days thought they had to erect their bridges in or near the shops before shipping, while American bridge companies could ship the parts to any point in the world and know that they would fit together exactly.

The plates of the Forth Bridge columns were fitted together in the shop before being sent to the site. While we would not build circular columns like those in that structure, those columns are still carrying their loads, because they are equally strong in any direction.

FRENCH: The visits to the Menai Strait and Conway bridges on this North Wales trip were, of course, of special engineering interest. At each crossing a suspension bridge, built by Telford to carry a highway, parallels a tubular bridge, built by Robert Stevenson to carry a railroad and a highway. The railroad and the two types of bridges each marked a notable advance in engineering at the time of their construction.

BRIDGE AT CHESTER OVER THE RIVER DEE
Reputed to Be Longest of Its Type in Great Britain in 1889

The road from London to Holyhead, on the Island of Anglesey, was one of the most notable and important of early English highways. Both the roadway and the bridges over the Conway River and Menai Straits were built under the supervision of Thomas Telford. The importance of this highway as a mail route led to its being paralleled within 25 years of its completion by one of George Stephenson's then newly developed railroads, built under the direction of the inventor's son, Robert, whose responsibility included the design and construction of the necessary bridges. Robert Stevenson was undoubtedly responsible for the adoption of the tubular-type bridges used at the Conway River and Menai Straits crossings, but the development of the structural details was almost entirely due to William Fairbairn and his experimental research.

While these tubular bridges, including the Victoria Bridge over the St. Lawrence near Montreal, appear crude and wasteful of material in the light of our present knowledge, they marked a very important step toward the later use of rolled iron plates and shapes in structural design. Attention may well be called to the artistic adaptation of these Welsh bridges to their surroundings, especially in the case of the Conway bridges, where the masonry outlines are so beautifully harmonized with the fine details of the ruins of old Conway Castle.

Noteworthy also are the facts that, in the case of the Menai Straits suspension bridge, though the approaches on both sides are carried on masonry arches, a full complement of vertical suspenders is used for appearance only; and that in the case of the tubular bridges, the masonry piers were in all cases built high enough to carry supplementary cables should they be found necessary to afford added supporting power to the new structural combination of rolled plates and shapes.

THOMSON: In England we got rooms and meals in apartments, which were often run by retired maids and butlers. These were then far better and more economical than American boarding houses—and more private. We could order or buy what we wanted for our meals.

Wherever we went in England that summer we were told that there was a great treat for us—gooseberry pie. I have never, before or since, tasted such large and delicious gooseberries.

The private gardens and hedges made a great impression, even more than they would now, because in those days there were not so many well-kept lawns and hedges in this country as at present. The old joke—about a man catching a cold when he fell asleep in the garden because some one had left the gate open—must have come from England, where the fences are veritable walls.

[On Wednesday, June 12, the various trips converged on London. Here, on the following day, began an elaborate succession of meetings, inspection trips, and receptions, to be described in some detail in the next article of this series.]

Need for Broad Training Indicated by University of Nebraska Questionnaire

By ROY M. GREEN, M. AM. SOC. C.E.

HEAD OF CIVIL ENGINEERING DEPARTMENT, UNIVERSITY OF NEBRASKA, LINCOLN, NEBR.

RESULTS of a questionnaire tabulated some time ago at the University of Nebraska show that, as many have suspected, engineers are an introspective lot. Further, in analyzing their own qualifications and contributions, they are anxious to help students improve their own training if possible. The form, prepared under the direction of Professor Green, was sent to over a hundred men in widely diversified fields of civil engineering. Many of the recipients were members of the Society.

"ENGINEERING" consists as much in the manner of doing things as in the character of things done. The "scientific approach" to problems may be outlined as consisting of the following five basic procedures:

1. Recognition that there is a problem, resulting in a clear statement of it.
2. Collection of all facts, or data, which bear upon the problem.
3. Analysis of the facts, separating those of primary influence from those of lesser importance and attaching the proper significance to each.
4. Correlation of the facts, to make a unified whole.
5. Formation of opinion and moulding of action, based upon this analysis.

After serving his apprenticeship as a "helper to a collector of facts" the young man should immediately begin carrying on all the other processes within a very limited field of activity and responsibility. As his proficiency as an analyzer of facts and a moulder of action improves, his field of action may be expanded and his degree of responsibility increased to such an extent that he becomes a "Professional Engineer." Since the responsibilities of the professional engineer extend to fields of human interest outside the purely technical field, it is essential that the young engineer be intelligently conscious of the influence of this work upon mankind. That this influence may be beneficial, his education should point toward broad professional idealism of unselfish, orderly service. The problem of the engineering college is to carry on its educational program in such a manner that a maximum number of its students may reach that state of achievement which characterizes the "Professional Engineer."

It has been thought that, for clarity in the process of discussion and study, this educational process may be divided into two fields—the field of knowledge and skills, and the field of habits. It is of course realized that these two fields of endeavor must be integrated into the unified life of the engineer in order that he may be an effective engineer and a useful citizen.

SUMMARY OF RESULTS

To gather opinions as to how the educational process can best fill these needs, a questionnaire was prepared at the University of Nebraska and mailed to a hand-picked group of engineers and men dealing with engineers in a professional capacity. One hundred and forty-four questionnaires were mailed. Of the 98 blanks returned, 44 contained more or less elaborate comments on the substance of the questionnaire or on the nature of the answers given. These comments varied from simple notations to as much as a 12-page discussion on engineering education. Practically all the comments were very constructive, showing extreme interest in the subject. Graphical tabulations of some of the findings appear in Figs. 1 and 2.

There were 14 discussions emphasizing the importance of concentrating education on fundamental subjects in engineering. As illustrations the following are offered.

A personnel director of a large aircraft manufacturing concern states: "The assumption in the first [that all engineering graduates have a good foundation] with respect to mechanics is not justified by experience. This subject is of extreme importance and should be emphasized accordingly."

A well-known authority on flood control problems states: "The reason for placing emphasis on the general basic courses is that a student engineer cannot foresee what he will be doing 10 or 20 years in the future."

An engineer practicing in the irrigation field offers the following: "From my own experience, if I had my college work to take over again, I would give more attention to fundamental studies such as mathematics, mechanics, and physics, and in the cultural field I would devote more time to rhetoric."

A very high percentage of those discussing the questionnaire emphasized the desirability of confining the education to fundamentals, but some had a much broader definition of fundamentals than others. The comment of a consulting engineer seemed to summarize the thoughts of many: "What you should learn at college is how to think and then use it principally as a preparation for forty years' more study."

ENGLISH, BOTH WRITTEN AND SPOKEN

Sixteen men of the 44 commenting stressed the importance of strengthening the training in English, both written and spoken. The following three statements are typical expressions of thought along this line.

A well-known consulting engineer stated: "So many men come to us who do not know how to handle the English language and particularly lack ability to express themselves in the writing of reports, that I believe that good grammar should receive some attention although it should be assumed that this has been acquired before reaching the engineering college."

A research engineer states: "The ability to think and write clearly, accurately, and concisely when reporting an investigation or work that has been accomplished in an attribute altogether too often lacking in the composition of an otherwise excellent engineer."

A sales engineer of a large production company makes the following statement: "We find in general that young engineering graduates are fairly well grounded in the technical subjects but that comparatively few of them are able either to write well or to speak well. In my opinion, a full year's course in public speaking should be a requirement for all engineers, and their laboratory and other reports should be graded fully as much on correct use of the English language and choice of words as on the technical accuracy of the data and the conclusions."

It appears impressive that without suggestion on the part of the questionnaire, so many men volunteered the conclusion that engineering education should be strengthened by finer achievement in the fields of written and spoken English.

BROADER EDUCATION URGED

There were 16 men who presented some form of argument in support of a broader foundation for an engineering education. These contentions were largely based on the fact that it is increasingly necessary for the engineer to assume a more responsible part in the conduct of the country's business, its government, all its civic activities. The following quotations are illustrative of this point.

An engineering author and authority on management states: "High top boots, and a woolen shirt have ceased to be the appropriate badge of a profession, most of whose members will have vastly more use for dress suits, and the manners and the courteous address that go with them."

An engineer specializing in water resources says: "A general knowledge of history, literature, psychology, and economics is essential to a well-rounded education, and an engineer should possess this knowledge in order that he may wisely use the technical education which has generally been offered."

A well-known authority on flood control uses the following words: "Like any other professional training, engineering should be based upon a broad non-technical foundation, as thorough as can be obtained without neglecting professional work. This idea is based upon the premise that an engineer must first be a member of a society and a citizen before he can be anything else."

The personnel manager for a large manufacturing concern states: "In my estimation the stature of any professional man is enhanced by an appreciation of spiritual values. Since the engineer plays such an important part around the conference tables of our industrial life he should be equipped to apply his engineering to better human relationships and economics as well as to great projects."

A materials engineer with a highway department states: "Any deficiency in the social sciences or other college preparatory courses which should have been taught in high school should be made up in the university, just as a deficiency in the physical sciences is required to be made up."

An executive connected with a large steel corporation makes his plea in the following words: "Therefore, it appears obvious, at least to me, that the course in civil engineering—and any other engineering course for that matter—although on the face of things conceived for a different and definite purpose, must also be considered as potentially the educational background for a variety of other indeterminate and divergent occupations. The end points and objectives for the students in all such occupations, however, both in and out of the profession, have one characteristic in common—the assumption of managerial duties and responsibilities. Therefore, should not preparation from all angles to grow into these responsibilities be the primary aim? This involves the inculcation of attitude, the development of method of approach to problems and to people to a degree greater than has characterized most technical courses in most schools. Therein lies the challenge to educators.

"The young engineer must be brought to the complete realization that each course he takes is not really a separate subject but is actually another increment to his sum of knowledge, which itself constitutes the whole and which must be identified and correlated and absorbed

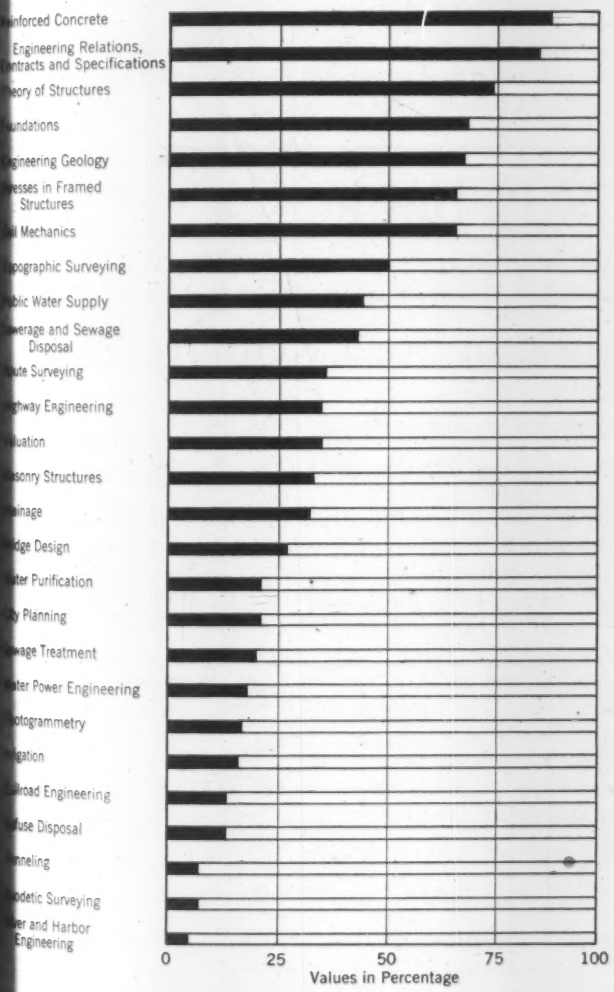


FIG. 1. RELATIVE IMPORTANCE OF CIVIL ENGINEERING SUBJECTS AS MEASURED BY RESULTS OF QUESTIONNAIRE

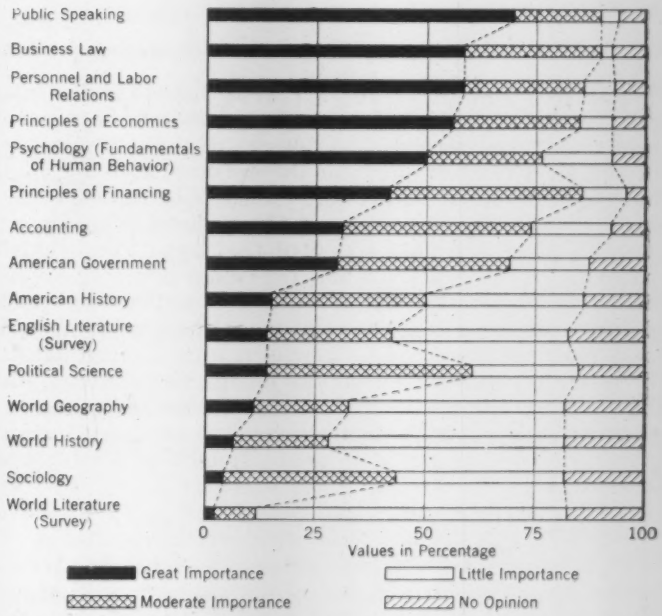


FIG. 2. RELATIVE IMPORTANCE OF NON-TECHNICAL SUBJECTS AS MEASURED BY RESULTS OF QUESTIONNAIRE

into the whole before it is of any value or significance. It is of even greater importance that he understand thoroughly that the purely technical phases of the world's business for which he is being given the rudiments of adequate equipment, is only a part—and actually a rather small part—of the world into which he is going. To narrow one's scope of contemplation and action down to the technical aspects of one engineering specialty is in itself the very worst kind of engineering, because such an approach ignores too many basic and vital factors."

It is a fact indicated by modern selective psychological tests that students of better-than-average ability are knocking at the door of the engineering college for training. Statistics also show that, at least at this institution, those with the highest potential personal capacities are those graduating from the engineering college. If these tests are valid, they indicate that these men will be the leaders of the future. It is certainly imperative that the engineering colleges prepare them for the highest possible type of leadership, unhampered by a narrow-minded or selfish outlook.

CHARACTER—HABITS—ATTITUDES ARE STRESSED

The list of personal characteristics given on the questionnaire brought forth the greatest number of comments and gave rise to suggestions as to many other characteristics, habits, or attitudes. A few of those suggested are: loyalty to employer, even temper, developed imagination, friendliness, good manners, tolerance, patience, enthusiasm, intellectual honesty. It is interesting to note that the matter of loyalty to one's employer or client was mentioned by a number of men, as was also intellectual honesty.

It is axiomatic that the character and personality of the engineer is the foundation upon which any professional activity must rest. If there is instability of character there is meager achievement. Many men indicated that all the habits and characteristics were "very important." Some added stronger words of emphasis such as "absolutely necessary" or "vital."

A personnel director of a large concern with wide property development makes the following comment: "While there is no definite pattern, there seems to be a tendency for civil engineers to gravitate toward managerial jobs where an engineering background of some kind is one of the fundamentals. This is why we place so much stress on some of the phases of character rather than on pure scientific ability."

A consulting engineer reports as follows: "From my observation of many of the leading engineers in the profession and an endeavor to evaluate the qualities which place them at the top, I believe it is essentially a combination of character, personality, and ability. I believe everyone at the top has developed what is termed character, and his relative position depends pretty much upon the extent to which personality and ability are combined with character. Some of our most brilliant engineers have been somewhat deficient in personality and there are other examples of engineers with an unusually fine personality but with less outstanding ability, who have been unusually successful."

It is not possible to develop all the personal characteristics and habits that may be desirable for an engineer, but it is well for the teacher to remember that the habits and attitudes he himself exhibits have an influence on the student and thereby affect his future attitude as a professional man.

Engineers' Notebook

Suggestions and Practical Data Useful in the Solution of Engineering Problems

Observations Reveal Deformation of Steel Reinforcement

By S. SERGEV

ASSOCIATE PROFESSOR OF CIVIL ENGINEERING, UNIVERSITY OF WASHINGTON, SEATTLE, WASH.

DURING and after construction of Biology Hall, University of Washington, a series of observations have been made and recorded to determine the deformation of the steel reinforcement in the concrete columns and beams. An early report and analysis of findings was made in the TRANSACTIONS of the Society (Vol. 99, p. 1343). Since the publication of that paper, additional readings have been recorded, providing conclusive evidence of progressive deformations. Readings on steel deformation were taken on two faces of six columns and two sides of six beams. Some readings on concrete deformation were taken on the compression side of the beams directly above the steel-deformation readings. These were eventually discontinued because quantitative use could not be made of them for lack of a reference specimen.

Deformation readings and corresponding compressive stresses in the basement columns are shown in Fig. 1. The concrete in these columns was a rich mix, 1:1:2. After 200 days, the theoretical compressive steel stress is approximately 4,900 and 8,500 lb per sq in., respectively, based on gross and core concrete areas. At the end of 10 years, the average indicated steel stress in the faces *N*, adjacent to the beams, is 36,000 lb per sq in., and in the opposite faces, faces *F*, 24,000 lb per sq in., or an average stress of 30,000 lb per sq in. The difference between the computed and the observed stresses is due to shrinkage effect. Also the steel stresses in faces *N* are approximately 50% higher than those in faces *F*. This differential is probably due to flexure

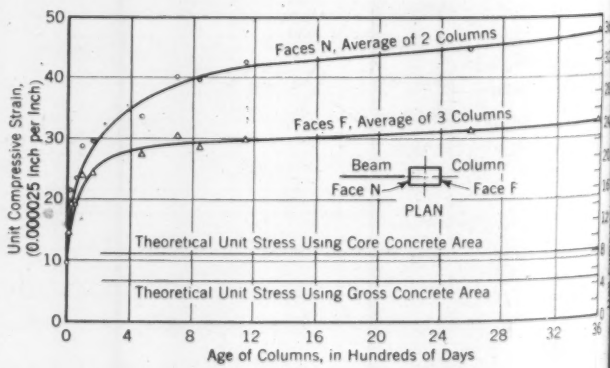


FIG. 1. DEFORMATION READINGS TAKEN ON BASEMENT COLUM

caused by continuity of action of the beams and columns joined to the columns under consideration.

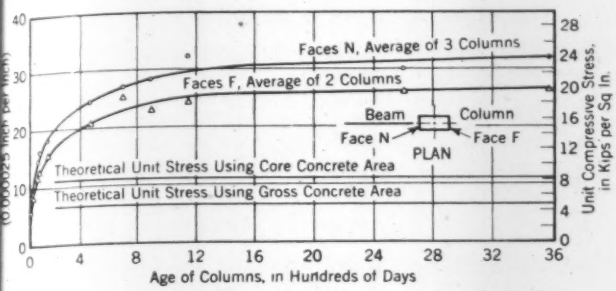

Faces N, Average of 3 Columns
Faces F, Average of 2 Columns
Beam
Column
Face N
Face F
PLAN
Theoretical Unit Stress Using Core Concrete Area
Theoretical Unit Stress Using Gross Concrete Area
Unit Compressive Stress, in Kips per Sq. In.
Age of Columns, in Hundreds of Days

FIG. 2. DEFORMATION READINGS TAKEN ON FIRST-STORY COLUMNS

First-story columns are of leaner concrete (1:2:4). Deformation in these members is given in Fig. 2. At the end of 10 years the theoretical compressive steel stress is 5,000 lb per sq in. based on gross concrete area and 8,400 lb per sq in. on core concrete area. The average observed compressive steel stress at that time was 22,000 lb per sq in. The difference between the computed and the observed stress is not so great as that for the concrete of richer mix, although conditions are practically the same. This merely confirms the well-known fact that lean concretes shrink less than those of richer mix when cured in air, and that the shrinking action continues for a long time.

The differential between steel stresses in faces *N* and faces *F* is, for these columns, substantially less than for the columns of richer mix. This might indicate smaller flexural effects. An explanation of this fact involves the mutual interaction of the members composing the structure as a whole. Referring to Fig. 3, showing the deformed shape of the structure, it is seen that in the basement story, at points where readings were observed, the steel stresses in faces *N* are apparently compressive. In the first story, owing to a reversal of curvature, there may be some doubt as to the character of the stresses in faces *N*. In any case, if there are compressive steel stresses in faces *N*, they are not likely to be as great as the corresponding stresses in the basement story. One fact is apparent: the structure tends to behave as a rigid frame and not as a group of simple beams and columns as designed.

Stresses in the tension steel of the beams under observation are indicated in Fig. 4. It can be seen that, for a considerable period of time, these stresses are compressive. This indicates that the shrinkage effect predominates over the load effect. Shrinkage of a reinforced concrete member produces compressive stress in the steel and tensile stress in the concrete. This action continues until the concrete fails in tension, allowing the steel to return partially to its elastically strained state.

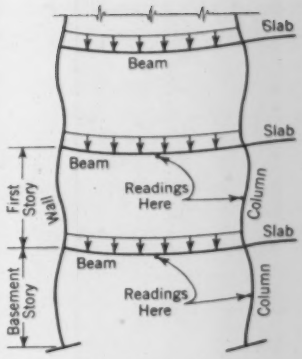


FIG. 3. DIAGRAM OF STRUCTURE SHOWING DEFORMATION TENDENCIES AND LOCATIONS OF READINGS

Such is the case with these beams. At the end of 10 years, with practically constant loading on the beams, the average observed steel stress is approximately 2,500 lb per sq in. in tension. On the basis of a simple beam—a doubtful assumption—and according to the usual assumption in T-beam design, the steel stress should be about 10,000 lb per sq in. The observed stresses are far from this, but the trend is upward. In time the difference between the observed and the computed stresses may be expected to become smaller but not to disappear completely.

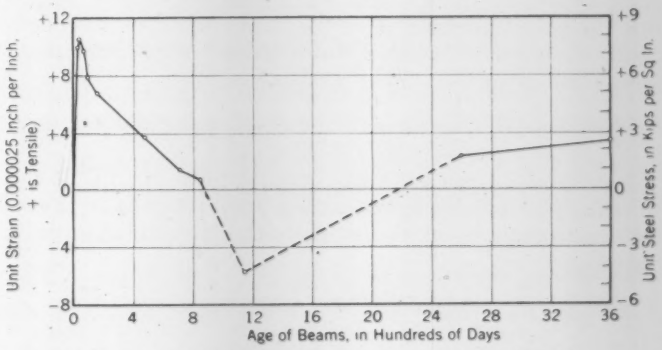


FIG. 4. STRESSES IN TENSION STEEL OF BEAMS

Column Stresses in Portals with Knee-Braces

By F. MORGENROTH
BRIGHTON, MASS.

ONE of the difficulties in designing frames stiffened by knee-braces is the computation of the moment in the column caused by the load on, or the deflection of, the girder and transferred to the column through the action of the knee-brace. The bending stresses caused by the knee-brace are in many cases, especially in narrow frames (boiler-frames, etc.), higher than the stresses from axial load and—in this case—actually govern the design. In the following, a simple formula based on the deflection of the members is developed.

A steel or wood frame, *ABCD*, has knee-braces *EF* and *GH* (Fig. 1). Assume that the girder *BC* is free to deflect at points *E* and *G* (knee-brace removed). Point *E* rotates about *B*, and the displacement is practically a vertical deflection. Call it δ.

A unit force $P = 1$ in the knee-brace has a vertical component $P_v = 1 \cos \alpha$, and a horizontal component $P_h = 1 \sin \alpha$. The force 1 cos α, applied at *E* causes a vertical deflection, Δ_1, at *E*. A force 1 cos α applied at *G* causes a vertical deflection, Δ_2, at *E*. The horizontal force $P_h = 1 \sin \alpha$ causes point *F* of the column *AB* to deflect by Δ_3. *AF* rotates about *A*; therefore the deflection Δ_3 is practically a horizontal displacement.

These deflections Δ_1, Δ_2, and Δ_3 are caused by a unit force $P = 1$ in the knee-brace. The actual

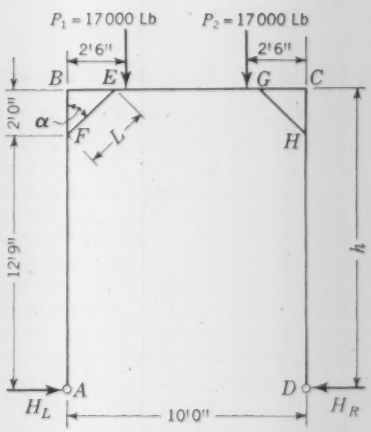


FIG. 1. BENT WITH KNEE-BRACES

force in the knee-brace is unknown. For symmetrical loading conditions, the forces in the two knee-braces EF and GH are equal. Call them X. The displacements caused by these forces are therefore $X(\Delta_1 + \Delta_2)$ for point E and $X(\Delta_3)$ for point F. In the final position of equilibrium, point E has deflected by $\delta - X(\Delta_1 + \Delta_2)$ and point F by $X\Delta_3$. The relationship between the two values can be seen from Fig. 2. The dotted line is the original position of the knee-brace before any load is applied. The heavy line is the position after the load is applied, and the equilibrium restored. It follows,

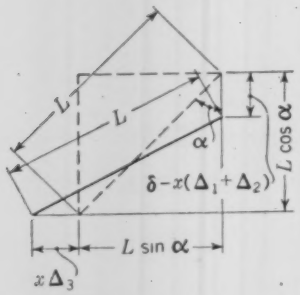


FIG. 2. RELATIONSHIP BETWEEN POSITION OF KNEE-BRACE BEFORE AND AFTER LOADING

from Fig. 2, that

$$L^2 = (L \sin \alpha + X\Delta_3)^2 + \{L \cos \alpha - [\delta - X(\Delta_1 + \Delta_2)]\}^2$$

Solving for X,

$$X = \frac{-2[L(\Delta_1 + \Delta_2)\cos\alpha + L\Delta_3 \sin\alpha - \delta(\Delta_1 + \Delta_2)]}{2[(\Delta_1 + \Delta_2)^2 + \Delta_3^2]}$$

$$\pm \frac{\sqrt{4[L\Delta_3 \sin\alpha + L(\Delta_1 + \Delta_2)\cos\alpha - \delta(\Delta_1 + \Delta_2)]^2}}{2[(\Delta_1 + \Delta_2)^2 + \Delta_3^2]}$$

$$\frac{\sqrt{-4[(\Delta_1 + \Delta_2)^2 + \Delta_3^2][\delta^2 - 2L\delta\cos\alpha]}}{2[(\Delta_1 + \Delta_2)^2 + \Delta_3^2]} \quad \ldots\ldots\ldots (1)$$

For the standard case, $\alpha = 45°$, the horizontal displacement of point F equals the vertical displacement of point E.

$$\delta - X(\Delta_1 + \Delta_2) = X\Delta_3;\ X = \frac{\delta}{\Delta_1 + \Delta_2 + \Delta_3} \quad \ldots\ldots (2)$$

Equation 1 represents the general solution, Eq. 2 the working formula for figuring the stress in the knee-brace. Because the moment at B is zero, the horizontal force H becomes

$$H_L = H_R = \frac{X \sin 45° \, L \cos 45°}{h} = \frac{XL}{2h} \quad \ldots\ldots (3)$$

and the maximum moment

$$M = H(h - L\cos 45°) = H(h - 0.7L) \quad \ldots\ldots (4)$$

For unsymmetrical loading and $\alpha = 45°$, the stresses in the two knee-braces are different. Call X the stress in the knee-brace EF, and Y the stress in the knee-brace GH. The other notation is as follows:

DEFLECTION	POINT DEFLECTED	LOAD CAUSING DEFLECTION	POINT OF LOAD
Δ_1	E or G	0.7	$E(X = 1)$ $G(Y = 1)$
Δ_2	E or G	0.7	$G(Y = 1)$ $E(X = 1)$
Δ_3	F or H	0.7	$F(X = 1)$ $H(Y = 1)$
δ_1	E	Actual load	
δ_2	G	Actual load	

Deflections δ_1 and δ_2 are based on the assumption that the girder is free to deflect (knee-braces removed). Then

$$\delta_1 - X\Delta_1 - Y\Delta_2 - X\Delta_3 = 0$$

$$\delta_2 - Y\Delta_1 - X\Delta_2 - Y\Delta_3 = 0$$

Solving for X and Y,

$$X = \frac{\Delta_2\delta_2 - \delta_1(\Delta_1 + \Delta_3)}{\Delta_2^2 - (\Delta_1 + \Delta_3)^2} \quad \ldots\ldots (5)$$

$$Y = \frac{\delta_1\Delta_2 - \delta_2(\Delta_1 + \Delta_3)}{\Delta_2^2 - (\Delta_1 + \Delta_3)^2} \quad \ldots\ldots (6)$$

These two values of X and Y would result in two different horizontal reactions (Fig. 1):

$$H_L = \frac{XL}{2h},\ H_R = \frac{YL}{2h}$$

To satisfy the equation $\Sigma H = 0$ there must be $H_L = H_R$. Therefore the difference, $H_L - H_R$, has to be applied as unbalanced shear with corrections for X and Y. In most cases Eq. 2 for symmetrical loading will apply.

For columns with or without restraint at the base, Eqs. 1–6 are valid. If the bases are hinged, the deflection formulas for a simple beam should be used. If they are partially or fully restrained, that should be considered when the deflection Δ_3 is figured. The influence of the longitudinal forces has been neglected as being small compared with the deformations caused by bending. For finding Δ_1, Δ_2, Δ_3 and δ, either the deflection formulas given in handbooks or one of the known methods for finding displacements (slope-deflection, virtual work, etc.) should be used.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Flood Control in the Missouri Valley

TO THE EDITOR: In his article in the October issue General Crawford has described the three floods that occurred in the Missouri River Basin during 1943, and the great losses and damages resulting from these floods. Data on hand at the time General Crawford presented his paper indicated calculable damages of $47,800,000 and the loss of eleven lives. More complete data available show that the calculable damages approximated $65,000,000 and the loss of seventeen lives.

In the spring and summer of 1944, floods again ravaged the rich agricultural lands along the Missouri River and its tributaries. In these floods most of the area that had suffered in 1943 was flooded again and, in addition, some areas that had previously escaped were flooded. Present data indicate that the 1944 floods have caused calculable damages of approximately $50,000,000 and the loss of thirteen lives.

Practically all the levees damaged in 1943 were repaired prior to the 1944 floods by the combined efforts of local interests and the Corps of Engineers under an Act of Congress passed in 1943 for the emergency repair of levees. However the bulk of these levees were again breached or seriously damaged by the high waters of 1944, thus demonstrating anew the inadequacy of the existing system of levees. The repeated destruction of these levees with the attendant damages emphasizes the urgent need for a completely coordinated plan of flood control for the protection of the Missouri Valley lands.

Adequate protection of these lands requires the construction of an integrated system of levee units and a series of reservoirs con-

trolling the flood flows that cannot safely be passed between the levees. Protection by the construction of levees alone would be impracticable because of the excessive width of flood way and the height of levees required.

On the other hand, it might appear that floods on the Missouri could be controlled by reservoirs alone. For certain types of localized storms, this would be true. However, for storms occurring in areas where suitable reservoir control cannot be provided, large flood discharges must still be confined by levees. This led to the development of the plan which General Crawford has presented.

In the selection of sites for the reservoirs included in the plan, careful consideration was given to all the needs and uses for water in the entire Missouri River Basin. Accordingly, all the reservoirs proposed in the plan would be multiple-purpose reservoirs to be utilized not only for the storage and control of flood waters but also for the conservation and use of water for irrigation, power, navigation, water supply, sanitation, and other purposes.

At the present time, there is an authorized navigation project for a 6-ft channel between Sioux City, Iowa, and the mouth, on which construction work is now substantially completed. Prior to the construction of the river improvement works, the Missouri River was free to wander from bluff to bluff, and in the course of its meanderings in its natural state it destroyed annually many thousands of acres of rich agricultural land by bank erosion.

One of the highly important accomplishments of the existing navigation project is the stabilization of the river banks—the resulting channel now "stays put." Prior to the river improvement work, all improvements in the river valley, such as farm lands and buildings, levees, railroads, highways, and bridges, were subject to direct attack by the river, and large sums were spent annually by local interests in protecting or restoring their structures. The stabilization of the channel to a fixed location within the flood plain was the logical first step in any overall plan for development of the river.

Although the so-called "Pick-Plan," described by General Crawford, is primarily a flood-control plan, it was designed to constitute a broad, flexible framework for the full development of the water resources of the Missouri River Basin, and it definitely contemplates that projects for irrigation, power, flood control, soil conservation, and other uses can and will be fitted into the plan, as circumstances warrant. It is purposely intended that the plan be modified from time to time to fit new and varying conditions as they develop. Future conditions that cannot now be foreseen can be adequately met, if this plan for development of the Missouri River basin is kept flexible, and no rigid rules which would bind future generations to a short-sighted policy are promulgated.

D. B. FREEMAN, M. Am. Soc. C.E.
Lieutenant Colonel, Corps of Engineers, U.S. Army
Omaha, Nebr.

Formulas for Characteristic Ordinates of Influence Lines

TO THE EDITOR: I should like to make an addition to my article, "Bending Moments in the Foundation Slabs of a Granary," in the October issue. In preparing Fig. 1 illustrating this article, the formulas for the characteristic ordinates of the influence lines were omitted by mistake. For the simple influence line these are:

$$M_1 = -\frac{L}{8}(1+\alpha)(1-\alpha^2) \qquad M_2 = -\frac{L}{8}(1-\alpha)(1-\alpha^2)$$

$$M_3 = \frac{L}{8}(1-\alpha^2)^2 \qquad M'_3 = \frac{L}{4}(1-\alpha^2)$$

For the combined influence line:

$$M_1 = -\frac{L}{8}(1-\alpha^2) \qquad M_3 = \frac{L}{8}(1-\alpha)^2$$

These expressions are essential for the computation of the maximum moment function and, therefore, have to be added to the paper.

PAUL NEMENYI
Assistant Professor of Mathematics
The State College of Washington
Pullman, Wash.

Credit for Chute-à-Caron

DEAR SIR: Articles in the July and subsequent issues, describing the Shipshaw development in Canada, record one of the greatest achievements in hydroelectric projects. Particularly valuable was the early history of the Saguenay River development, including the important but frequently forgotten promotional services rendered by certain venturesome financiers and engineers. This is a story of vision and courage on the part of those willing to risk their fortunes, and of engineering skill shown by leading hydraulic engineers whose principal characteristic was a strong and vigorous initiative in matters involving great personal responsibilities.

Among engineers deserving of recognition in connection with the development of the Saguenay River, I would like to add the late James W. Rickey, M. Am. Soc. C.E., under whose direction the first stage of the Shipshaw Project was constructed. This work was then known as the Chute-à-Caron Project. When the Aluminum Company of America acquired a controlling interest in the power site in 1925, engineering responsibilities for subsequent development were automatically transferred from W. S. Lee to Mr. Rickey, then chief hydraulic engineer of the Aluminum Co.

In all the studies made up to 1928, the Chute-à-Caron Dam was merely considered a diversion dam in the overall Shipshaw scheme for utilizing the total potential head. It was quite natural to conclude that a diversion dam was not the logical site for a power house. However, after more detailed studies of the time involved for constructing the comprehensive Shipshaw Project, a power house with a capacity of about 20% that of the main power house proved to pay for itself in relatively few years. Other advantages, some mentioned in the paper, were also disclosed, and finally there was the consideration that, if for economic reasons, it became necessary to postpone construction of the second stage of Shipshaw, a substantial block of power would still be produced from the first stage.

As it actually turned out, the depression of the early thirties occurred, just about the time the Chute-à-Caron Project was being completed, and it would have been recorded as a grave error in judgment if the dam had stood there all these years as a simple diversion structure without means to earn a revenue. Under the circumstances, the decision to build a 250,000-hp power house was not only a bold one, but, as later developments have disclosed, a most fortunate one.

There is a further interesting sidelight with respect to the first power house. Mr. Rickey was noted for his generosity in giving credit to others; he mentioned that the idea for this power house was developed when he was conducting his Board of Directors over the site. One of the directors, J. E. Aldred, a noted financier in the hydroelectric field, raised the question of building a temporary power house to earn a return on the initial stage of investment while the main project was continuing under construction, and Mr. Rickey's subsequent studies established the merits of this idea. This was a case where a financier contributed an important idea, which Mr. Rickey was quick to recognize.

In connection with the construction of the Chute-à-Caron Dam, the building of a pre-cast dam on end known as "The Obelisk" was further evidence of Mr. Rickey's courage and rare ingenuity, for which his name deserves mention. This project was the subject of a most interesting paper leading off the third issue of CIVIL ENGINEERING—in December 1930.

Pittsburgh, Pa. ADOLPH J. ACKERMAN, M. Am. Soc. C.E.

Technology in the Economic Structure

TO THE EDITOR: There are parts of Miss Eaves' article on "Facts and Figures on Construction Trends," in the November number, with which I must take issue. Lowering costs is one thing; stabilizing the national economy is something entirely different.

Suppose that costs are lowered by introducing technological improvements into the construction of buildings. What will be the results? First, the building industry will be strengthened in its competition with all other industries. Some buying will be shifted from other goods to buildings, but what the building industry gains other industries will lose. Second, some currently created buying power now going into savings and some dormant buying power will be used for new buildings. For practical considerations, buying power coming from these two sources may be looked upon as new. Third, more unemployment will quite prob-

ably be created. Lowering costs by creating unemployment is a method of taking purchasing power from some people and distributing it in the form of lower prices to others—a concentrating process.

As far as stabilizing the national economy goes, these three results are, respectively, neutral, constructive, and destructive. Whether the constructive results are greater than the destructive ones cannot be determined beforehand. Knowing, however, that unemployment has long been a major problem, one suspects that merely lowering costs will make a bad condition only worse. Reducing prices and creating unemployment are two operations in the process of raising our standard of living. But if we are primarily concerned with stabilizing our economy, the policy of "first things first" demands that we discover why the process of raising our standard of living ends with the creation of unemployment. Increasing the ability to produce while decreasing the ability to buy seems to be an absurdity. Today the real economic problem is to determine what alterations are needed to insure that the producing processes distribute purchasing power in the manner required to sustain full employment. The real challenge to engineers lies in the question, "Can we maintain the freedom of enterprise and all that goes with it?"

It seems to me that the statement, "technology creates employment," is a falsity, which can give rise only to false conclusions. Technology prepares the way for us to raise our standard of living. It makes available additional effort, both mechanical and human, for the production of more goods; it increases our ability to produce. It enables us to squeeze labor effort out of the existing producing processes, and it creates unemployment. Only as long as production can be carried on with ever-decreasing labor effort can our standard of living continue to rise. Technology enables us to produce goods more cheaply and, so, makes possible lower prices to consumers. Lower prices, not accompanied by a reduction in purchasing power, create the market required to sustain additional production. Technology also, opens up new fields for industry by developing new materials, new processes, and new devices. It provides a very large assortment of new things from which we can select those best suited for better living. Thus technological progress is essentially an enabling process.

Technological progress corresponds to the preliminary work and clearing which must precede the construction of a building. However, just as clearing operations are not necessarily followed by actual construction work, so technological progress is not necessarily followed by constructive processes. Moreover, if we keep on clearing sites and do not build the structures, we will most likely ruin a great deal of property; and if we continue not to build on technological progress, we will most likely wreck our economy.

GEORGE C. HAUN, M. Am. Soc. C.E.
Oakland, Calif. *Structural Engineer*

In Behalf of Private Practice

TO THE EDITOR: Of recent years there has been a pronounced trend toward the performance of government engineering work by firms engaged in private practice. This trend received impetus from the Army and the Navy, who found it desirable and necessary to employ the services of established architect and engineer organizations to complete many assignments for planning, designing, and supervising the construction of a vast number of military facilities. In recent months many government offices have found themselves unable to proceed with the planning of postwar construction work with their own personnel, and have invited the cooperation of well-established private engineering firms.

In my opinion this is an excellent time for engineers to enter the field of private practice, and I am inclined to urge such activity upon men engaged in the public service or employed on the staffs of industrial firms but eager to undertake the exhilarating activity incident to the work of a private engineering firm.

Anyone who enters private practice should never lose sight of the important element of overhead expense, which is a substantial and continuing item of cost in a private engineering office. Public offices are very apt to be unaware of overhead expenses, but an engineer in private practice who is not continually mindful of such expense is apt to find himself operating without profit. A good way to express overhead expense for a private engineering firm is to list it as a percentage of productive labor costs. When that is done, a considerable part of total payroll expense, 10 to 30%, will be found to be included under the category of overhead. Such dead payroll time includes time spent on promotion of new engagements, the activities of professional societies, vacations, illness, holidays, attendance at funerals, and the like.

The experience of the writer's firm indicates that total overhead expressed as a percentage of productive wages will vary from 50 to 100%, depending on whether salaries paid are modest or fairly high, on the volume of engineering fees obtainable during a given period of time, and on the skill and diligence displayed in reducing overhead expense to a desirable minimum. Substantial overhead expenses are necessary for an engineering firm in private practice which renders good service, which is always on the alert for new engagements, and which aims to conserve in every possible way the time of principals and key men so that they can be spared a multitude of administrative and business details.

While the writer is fully conscious of the splendid service performed in recent years by the engineering staffs of many public bodies, like the Army and Navy, the Tennessee Valley Authority, the U.S. Bureau of Reclamation, the State Highway Departments, and the staffs of industrial firms, he nevertheless believes that there is good reason for expanding the private practice of engineering, and that many men now in the public service would be justified at present in seeking entry into the field of private practice, either by joining an established firm or by creating a new firm.

After 24 years in private practice the writer returned to public service for a period of one year, after which he was very happy to return to private practice and to forsake the benefits of tenure of office, retirement pay or pension, less responsibility, less risk as to net income, and a less fatiguing work schedule.

The writer is also constrained to add that, of course, war jobs must come first. Obviously no one should forsake an important post in the war effort at this time to seek better oppportunity outside government or industrial employment.

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Consoer, Townsend & Associates,
Chicago, Ill. *Consulting Engineers*

Forum on Professional Relations

CONDUCTED COLUMN OF HYPOTHETICAL QUESTIONS WITH ANSWERS BY DR. MEAD

In this issue Dr. Mead answers Question No. 29, which was given in the December issue of "Civil Engineering." The question stated that: "A member of a St. Louis (Mo.) consulting firm was recommended by friends to an out-of-the-way municipality in lower Louisiana, to provide plans and specifications for, and superintend the construction of, a water works plant. The consulting engineer, learning that the officials and citizens of this municipality had no experience in employing consulting engineers, entered into an agreement to do the work for them without any stipulated price. Later, he sent them a bill for his services at a rate 50% higher than he would have asked for the same services in Illinois. What is the ethics in the case?"

In the writer's own practice his charges would always be the same whether his clients asked about them in advance or not. In fact, he has always insisted that his clients thoroughly understand the basis of his charges before undertaking their work. Furthermore, he would feel that it was dishonest to take a job without such an understanding and then to raise his price above his regular charges.

DANIEL W. MEAD, Past-President
Madison, Wis. and Hon. M. Am. Soc. C.E.

Question No. 30, which was announced in the January number, will be answered in the forthcoming, or March, issue. Next in the series, the following question is announced. Replies may be received until March 5, with answers in the April issue.

QUESTION NO. 31: *A young man is in the employ of an engineering concern, which is supervising the work being done by an honest and reliable firm of contractors. The contractors, having had an opportunity to observe the young man on the job and to see that he is very capable, offer him a position in their organization at the same salary he is getting from the engineering concern. If the young man feels that he is bettering himself and gives his employer sufficient notice, is he justified in taking the new position while the engineering firm and the contractor still have business relations with each other?*

SOCIETY AFFAIRS

Official and Semi-Official

John Cyprian Stevens, President in 1945

BECAUSE of the wide variety of his activities, John Cyprian Stevens is well known in engineering circles. He will be recognized at once as an authority in hydraulic matters, as a business man who manufactures engineering instruments, as an active Society member and officer, and as a public-spirited citizen. Whatever the task may be—and he is always active—it will be found that he does it well. He is not content with mediocrity but aspires to competence; and he has been successful in this to a marked degree. Those who have known him best and longest think of him as a hard-working engineer—devoted to his profession and its advancement. Since, then, he is first and foremost an engineer, consider for a moment his professional life. Naturally it started with his training. He was born in Kansas, at a time when great herds of buffalo roamed its western prairie. He received his early schooling in the small town of Knoxville, Iowa, and his collegiate training at the University of Nebraska. Although he is a product of the Plains, his ancestors came from New England. His father was Charles Freeland Stevens, a "down-east Yankee" from Paris, Me. His grandfather was Dr. Cyprian Stevens who practiced medicine in the same community. He belongs in the seventh generation of Cyprian Stevens, who emigrated from England to America in 1660.

JOHN CYPRIAN STEVENS, PRESIDENT FOR 1945

A VERSATILE MAN

During the Spanish War, he served in the Philippines in the 51st Iowa Volunteer Infantry. In his undergraduate days, he was for five months assistant state engineer of Nebraska, for ten months assistant engineer in the U.S. Reclamation Service, and for 17 months engineer for the U.S. Geological Survey. How he was able successfully to complete his college work with these interruptions is something only he himself can explain. He was a protégé of the late O. V. P. Stout, M. Am. Soc. C.E. (former Dean of Engineering, University of Nebraska). Dr. Stout was wont to point to Stevens as the most versatile student that ever came under his direction. He would recount that Stevens once ran a newspaper in Iowa, setting most of the type and writing many of the editorials, and running the paper off weekly on an old Washington hand press; he paid most of his way through the University by doing carpenter work; he played the piano for dances; he played in the University band and conducted a band at the neighboring Union College; ran the astronomical observatory during summer vacations; and was an acrobat in the gymnasium.

After leaving Nebraska, he worked five years for the U.S. Geological Survey, finally as District Engineer in charge of work in the Pacific Northwest, with headquarters at Portland, Ore. He resigned from Government service in 1910 and since then has been in private practice in the Northwest, except for the years 1912–1914, which he spent in Spain for the Pearson Engineering Corporation on studies, design, and construction of hydroelectric developments. Upon returning from Spain, he was selected chief engineer in charge of design and construction of the West Okanogan Valley Irrigation District project in Washington. Thereafter he resumed his private practice in Portland and in 1920 formed partnership with R. E. Koon, M. Am. Soc. C.E., which has continued ever since. The work of this firm, which is one of the largest in the Pacific Northwest, has covered engineering and financial studies, valuations, design and construction of hydroelectric plants, water systems, purification plants, sewer and sewage disposal works, and irrigation developments in the firm's chosen territory. War work of the firm included the $16,000,000 Umatilla Ordnance Depot, consultation on water supply for the Fort Ord Cantonment, and the design of utilities of the Walla Walla and Moses Lake airfields. Mr. Stevens has been consultant for the U.S. Engineer Department on a variety of important developments, including the hydraulic studies for Bonneville Dam, and flood control dams in the Portland and Seattle Districts. He was a member of the Board of Engineers for the Portland Sea Wall Intercepting Sewer and Sewage Pumping Plant in Portland; for the Board of Review on the Contoocook River Basin in New Hampshire, for the Board of Engineers for Rivers and Harbors; on studies of the Colorado and Arkansas rivers and the Rio Grande for the National Resources Planning Board during the life of that organization; on studies of the Colorado River Basin for the U.S. Bureau of Reclamation; and on work for the Washington Water Power Company, the Pacific Power & Light Company, the Anaconda Copper Mining Company, and the Montana Power Company, among others.

In the business field, Mr. Stevens has been for over 30 years active in the manufacture of engineering instruments. In 1911 he made arrangements with the firm of Leupold and Volpel to manufacture a water level recorder which he had designed and patented. After his return from Spain, Mr. Stevens was taken in as a partner of the firm, and the development of new types of instruments for all kinds of engineering work was successfully undertaken. The firm name has since been changed to Leupold and Stevens Instruments. Surveying and navigation instruments made by the firm carry the name "Leupold," while other instruments such as water level recorders, flow meters, remote registering systems, snow and

rain recorders, radio-operated recorders, and controls carry the name "Stevens."

In addition, he is a hydraulician who knows water—not merely by studying but by experimentation and use, and deep practical experience. His eminent consulting assignments bear out this fact. Few American engineers have given as much to modern hydraulic literature on the basis of cold, hard experience and personal research accompanied by mathematical deductions. This happy mixture of the theoretical and practical has served him well.

His writings, of which a generous portion have been for the Society, cover scores of topics mostly in relation to hydraulics. He was chairman—and a working chairman, too—of the committee that developed Manual 25, *Hydraulic Models*. Another of his committees formulated Manual 11, *Letter Symbols and Glossary or Hydraulics*. He was chairman of the committee of the American Standards Association which, with Society participation, compiled "American Standard Letter Symbols for Hydraulics (ASA-Z10.2-1942), approved by the Association in 1942. His paper on "The Silt Problem" received the Society's Norman Medal in 1937. Another paper, "The Future of Lake Mead and Elephant Butte Dam," is now awaiting publication in PROCEEDINGS. Evidence of his interest in these matters is his endowment of the J. C. Stevens award, being granted this year for the first time.

He was one of the founders of Sigma Tau, honorary engineering fraternity, founded at the University of Nebraska. He served as its national president in 1928–1932, and has received its gold medal. In 1938 he was honored by the degree of Doctor of Engineering by the Oregon System of Higher Education.

EXTRACURRICULAR ENDEAVORS

These details are not intended to imply that his life has been all work and no play, for he has given much time to civic, cultural, and athletic activities. His capacity to take active part in these affairs has been a constant source of amazement and admiration to all of his associates. He has had membership on the Oregon State Conservation Commission, Super-Power Survey of the Pacific Northwest, Oregon State Board of Higher Curricula, Portland Traffic Safety Commission, Portland Postwar Development Committee, Portland Chamber of Commerce, Rotary Club, Irvington Club (Tennis), Y.M.C.A., Oregon Museum Foundation, Inc., and the Geological Society of the Oregon Country, of which he has been president.

In the Society he has been a member of the Committee on National Reclamation Policy, secretary for eleven years of the Special Committee on Irrigation Hydraulics, chairman of the Executive Committee of the Power Division for four years, chairman for ten years of the Committee on Hydraulic Research, and Director for District 12, 1932–1934.

In addition he has somehow found time for indulging in recreational pursuits. He admits playing a poor game of tennis, a somewhat better one of badminton, and still emasculates piano pieces to the annoyance of his family. He says that he has always had a flair for dramatics but never had time to indulge the whim. Nevertheless, the fact remains that he has spent many hours studying the plays of Shakespeare, with the result that he can recite many long scenes from memory while dramatizing the various characters. He has entertained both club and private audiences with his readings from the Immortal Bard.

How he has found it possible to accomplish these feats of memory and at the same time carry on his heavy professional and business load must remain a mystery. Mrs. Stevens is authority for the story that often, in the prewar days when gasoline was available and he made long trips in the discharge of his engineering duties, he would attach a page from some play to the steering wheel of the car, beguiling himself by memorizing and rehearsing scences and acts, since he could not be heard by other travelers hurrying past.

By some members of this Society he is said to be a tough customer on the opposite side of a chessboard. He is an amateur geologist and enjoys hikes in search of fossils and minerals in the area of his endeavor, although he does not maintain a collection, but gives away most of his specimens to others. Specimens have been loaned to the Museum of Oregon State College and also to the Department of Geology and Mineral Industries.

In his personal relations he is warm hearted and kindly. A young engineer who comes to him for advice will find him willing to lay aside his work and discuss with him his personal problems. Through committees of his Local Section, he has given vocational guidance to many high school graduates who thought they wanted to embark on an engineering career. For years he and Mrs. Steven have maintained a lovely but quiet home in Portland. They ha four children, one of whom is a grandchild who has been raised an was adopted by them. Mrs. Stevens, by the way, is also w known among Society members and is the 1945 president of th Women's Auxiliary to the Oregon Section of the Society, and noted for her charm and sociable nature. It is expected that bot of them will have opportunity during the coming year to exten still further their already wide acquaintanceship in the Society.

All will agree that J. C. Stevens fully deserves the honor he is no receiving, on account of his long record of brilliant work in behal of the Society and the profession. History will also doubtles prove the other side of this relationship, that the Society likewis is fortunate in having such a many-sided and capable man for it official head. His many friends will wish him great success and will actively work under his inspiration to ensure that succes during his term as President of the Society in 1945.

Board Issues Statement on Employment Conditions

After considering the report of the Committee on Employment Conditions for the year 1944, the Board of Direction, at its January meeting ordered that the following statement be published in "Civil Engineering."

The Board is convinced that a real problem in employment conditions concerning professional engineering employees exists and is likely to continue. The right of American citizens to form lawful organizations having group interests is as old as our Constitution itself. The National Labor Relations Act (the Wagner Act) defines and stresses that right so far as collective bargaining in general is concerned and renders it unlawful for "an employer to refuse to bargain collectively with the representatives of his employees." Even without the Act, laboring men or professional workers could group together in their own interests either separately or jointly as they chose.

One phase of the present problem is the growing tendency for labor organizations of non-professional workers to use the provisions of the National Labor Relations Act in forcing professional employees against their will to become members of non-professional groups. In such case and against his will, the professional employee must quit his job or pay dues to the non-professional group and assign to it his rights to bargain with his employer regarding pay, hours, promotions, vacations, layoffs and all other employment conditions. In other cases professional employees, while not forced to join non-professional groups, are none the less under the complete domination of a non-professional group regarding all matters of employment conditions. Another phase of the problem is the apparent lack of information and initiative among professional men as to appropriate methods to be taken when necessary to avail themselves of the benefits of group organization possible under existing federal law and regulations.

The proposals for a solution of the problem as originally recommended and then modified by the Board on further legal advice, are believed to afford the best if not the only practicable solution of the problem possible at this time.

The Board reiterates its recommendation that each Local Section of the Society establish a Local Committee on Employment Conditions, a function of which should be to keep abreast of labor laws and regulations and of local employment conditions as they affect engineers. Members of Local Sections should be kept informed by their Committees so that employees concerned may be assured an opportunity, before the door is closed against them on matters of collective bargaining, to consider possible courses of action so they themselves may choose the one they wish to pursue. It is not so important how these local employment conditions committees come into existence as it is that they be organized and function actively in the interest of the professional employee and employer. An essential duty of each committee should be the "know how" and the readiness, when circumstances dictate, to help in the formation of professional employee collective bargaining units. A most helpful function of the Local Committees on Employment Conditions would be to keep alert to local employment conditions and act in the negotiation and conciliation of engineer employer-employee differences.

NOTES FROM THE CAPITAL

Occasional Information of Interest to Engineers, Observed by the Society's Washington Representative, and Believed Worthy of Wider Attention.

National Highway Development

Two New Systems Created by Legislation Just Enacted

THE FEDERAL-AID Highway Act of 1944, approved by the President in December, marks the beginning of a new period in highway development in the United States. It provides $500,000,000 for construction of highways in each of the first three postwar years and requires the designation of two new highway systems in addition to the existing federal-aid system. One is to be the National System of Interstate Highways connecting the principal metropolitan areas, cities, and industrial areas and to serve the national defense. The other is to consist of the principal secondary and feeder roads, including farm-to-market roads, rural free delivery mail and public school bus routes, either outside or inside municipalities of less than 5,000 population.

The annual authorization of $500,000,000 is assigned as follows: $225,000,000 for the federal-aid system, $150,000,000 for secondary or feeder roads, and $125,000,000 for the federal-aid highway system in urban areas. Since the new national interstate system is to be included in the federal-aid system, both the $225,000,000 and the $125,000,000 will be available for expenditure on this system.

Funds for the federal-aid system are to be apportioned among the states, one-third in proportion to area, one-third in proportion to population, and one-third in proportion to mileage, rural free delivery and star routes. The funds for secondary or feeder roads are to be apportioned according to the same formula, except that rural population (includes population in places of less than 2,500) will be substituted for total population. No state is to receive less than one-half of 1% of the funds. The funds for urban projects on the federal-aid system are to be apportioned in proportion to population in urban places of 5,000 or more. The law does not specify any minimum amount to be received by a state.

For the first postwar fiscal year, funds are to be apportioned within 30 days after approval of the Act but, with the exception of $100,000,000, may not be used in payment on construction contracts entered into before proclamation by the President of termination of the emergency or authorization by concurrent resolution of the two Houses of Congress. To permit the making of surveys and plans for the large program authorized, the Act provides that $100,000,000 of the funds for the first year may be appropriated and become available immediately upon apportionment.

The large highway program authorized is to be carried on under the long-established plan of cooperation between the states and the Federal Government in constructing the federal-aid system. Under this plan the state highway departments are responsible for initiation of projects, preparation of plans, letting of contracts, and supervision of construction. The Public Roads Administration of the Federal Works Agency is responsible for administration of the program and all steps are subject to its approval. The law provides that it may enter into contracts only with the state highway departments.

Routes of the national system of interstate highways are to be selected by joint action of the state highway departments of each state and the adjoining states, following the procedure used in designating the federal-aid system. Each state will be responsible for initial designation of the sections of the system within its borders, and the state designations will be coordinated into a national system, possibly through group and regional meetings of state highway departments with representatives of the Public Roads Administration.

Limitation of the national system of interstate highways to 40,000 miles will permit inclusion of only the most important main highways. Features of this proposed development were covered in papers by Commissioner Thomas H. MacDonald, Hon. M. Am. Soc. C.E., and Deputy Commissioner H. S. Fairbank of the Public Roads Administration, in the May and June 1944 issues of CIVIL ENGINEERING.

In general the Federal Government is to pay 50% of the cost of highways, including surveys, preparation of plans, and construction costs. Greater participation is permitted in the public-land-states, the increase in percentage of participation being one-half the percentage of land in the state held as public land. A new and important feature is the provision that federal funds may be used to pay one-third the cost of right of way.

Not more than 10% of any of the funds authorized may be used to pay the full cost of the elimination of hazards at railroad grade crossings, with the exception that federal participation in cost of right of way on grade-crossing elimination projects is limited to 50% of the cost to the public. The railroads are required to pay the United States for net benefits received from the elimination of hazards at crossings. The amount to be paid is limited to 10% of the cost.

Previous federal highway policies are continued by authorizations for each of the first three postwar fiscal years as follows: $37,500,000 for roads in national forests; $4,250,000 for roads in national parks and monuments; $10,000,000 for parkways to give access to national parks and monuments, or to become connecting sections of a national parkway plan; and $6,000,000 for roads in Indian reservations.

The federal share in all these highway activities is carried on under Mr. MacDonald, as Commissioner of Public Roads.

Notes Taken at the New York Annual Meeting

AS STATED on the program, at ten o'clock on Wednesday morning, January 17, the Annual Meeting opened with impressive ceremonies. Yes, presentation of honors and technical programs opened Wednesday, but a hard-working Board of Direction had been for three days handling business essential to Society activities. For a detailed account of the actions of the Board see the abstract on pages 104 and 105 of this issue.

All told, about 1,725 members and guests attended, justifying the decision which moved Meeting sessions from the Engineering Societies Building to the more spacious Hotel Commodore. As can be imagined, traveling was the number-one problem of the majority of the delegates. Stories range from that of the member who stood in a washroom all the way from Chicago, on down to that of the hardy New Jersey engineer who, finding bus service interrupted by an unusually heavy snowfall, plowed through on foot to the nearest rail line. Several Directors did not arrive until a day or more later than they had planned. Nevertheless the consensus of opinion seemed to be that time taken from pressing business to attend Society sessions paid dividends. For instance, at the Thursday morning meeting of the Structural Division over 325 men assembled to hear an analysis of recent examinations and calculations on the condition of New York's Brooklyn Bridge.

Confining this report more strictly to the three-day Meeting, January 17 to 19, first mentions must be made of the impressive ceremonies Wednesday morning. This session was held in the Grand Ballroom of the Hotel Commodore. Presentation of honors and prizes is a measure of professional growth; therefore it was inspiring to witness award of the highest honor in the engineering profession to a civil engineer—the John Fritz Medal. This was presented in absentia to John L. Savage, Hon. M. Am. Soc. C.E. Chief Designing Engineer of the Bureau of Reclamation. Mrs. Mary C. Winston of Denver, Colo., Mr. Savage's sister, represented Mr. Savage, who is in China, making a study of importance to the Chinese Government.

Also at the Wednesday morning session, certificates of Honorary Membership were presented to Arthur J. Dyer, Gen. C. P. Gross, Prof. Horace W. King, Louis C. Sabin, and Arthur Surveyer. Prizes for outstanding contributions to engineering publications were also handed to seven winners.

Ralph B. Peck, Professor at the University of Illinois, received the Norman Medal. For further information about these prize winners see page 43 of the January issue of CIVIL ENGINEERING. The J. James R. Croes Medal was presented to Prof. W. M. Wilson, who represented Prof. Nathan M. Newmark, also from the University of Illinois. For his paper on aspects of the depreciation problem, Prof. Eugene L. Grant, of Leland Stanford University,

received the Thomas Fitch Rowland Prize. The James Laurie Prize went to Gordon R. Williams of Washington, D.C., while the Collingwood Prize for Juniors was presented to Walter L. Moore of California, represented by Prof. Franklin Thomas.

On this occasion the first award of the J. C. Stevens Award was made. This award is novel in that it consists of technical books of the prize winners' own choosing, and it is therefore much valued. Recipients of the first award were Prof. Boris A. Bakhmeteff, chairman of the Society's Hydraulics Division, and Nicholas V. Feodoroff, research associate at Columbia University.

The retiring Board of Direction reported 1944 activities at the Wednesday session. For a full account see item, page 101. After the final canvass of ballots for new officers was reported, President-elect John C. Stevens and other new officers were introduced. Enthusiastic approval of the work of outgoing officers was expressed in an ovation at the close of the morning session.

Those attending the Wednesday luncheon were addressed by G. Donald Kennedy, Chairman of the Society's Committee on Postwar Construction on the problems which have arisen in the preparation of plans for postwar works and on the progress which has already been made. Mr. Kennedy said that planning for private projects to be constructed after the war is won is lagging far behind the preparations being made by public agencies. "Our objective is to see that preparations are completed before the war's end for 15 billion dollars in construction for the first postwar year," stated Mr. Kennedy.

Wednesday afternoon was given over to meetings of three Technical Divisions. The Construction Division, the Sanitary Engineering Division, and the Surveying and Mapping Division discussed topics of current importance. As is the case with all technical sessions, many of the papers presented will later be printed in Society publications—up to the capacity of PROCEEDINGS and CIVIL ENGINEERING.

A reception for the incoming President and the Honorary Members was held Wednesday evening in conjunction with the dinner and dance. Despite their formal attire, it was unusual to come upon a group in conversation who were not talking shop—doubtless to the disgust of the ladies. It would lead one to accept the admonition that engineers must recognize two uniforms of their profession—boots and mackinaw, and a dress suit.

Thursday morning sessions were held by the Hydraulics and Waterways Division (a joint session), and by the Structural Division and the Sanitary Engineering Division. All subjects discussed concerned problems arising out of the war or the principles which will guide engineers in an energetic postwar program. For instance, at the Sanitary Engineering Division meeting, water supply on the battle front was discussed, followed by an appraisal of the depletion of ground water supplies, and a paper on postwar planning in sanitary engineering.

Thursday afternoon and all day Friday were completely occupied with technical sessions. Nine Divisions joined in this attack on technical problems.

Large attendance at all technical sessions would indicate a serious intent on the part of those present. As in days gone by, provision was made for entertainment in addition to the technical sessions. Apparently a more strictly professional interest was the motivating force this year, for the attendance at the technical sessions was larger than that at all the social gatherings combined.

All things considered, this wartime meeting, the only one the Society is to hold during the year, was notable in every respect.

TRANSACTIONS Promised in March

A STILL further change has had to be made in the publication schedule for TRANSACTIONS. To issue it as Part II of the February PROCEEDINGS would mean to delay the latter. To avoid this, it has been decided to mail TRANSACTIONS as Part II of the March issue of PROCEEDINGS. It is certainly hoped that this expectation can be realized.

The delay in issuing TRANSACTIONS, like all others concerning Society publications, must be charged to war conditions—including shortage of both materials and manpower. Since the expediting of the war effort is rightly the first consideration, these inconveniences are willingly undergone.

Final Ballot on 1945 Society Officers

To the Ninety-Second Annual Meeting *January 10, 1945*
American Society of Civil Engineers:

The tellers appointed to canvass the ballot for officers of the Society for 1945 report as follows:

For President

John Cyprian Stevens	4,683
Scattering	10
Blank	8
	4,701

For Vice-Presidents

Zone II:

Armour Cantrell Polk	4,682
Scattering	4
Blank	15
	4,701

Zone III:

Ernest Emmanuel Howard	4,674
Scattering	8
Blank	19
	4,701

For Directors

District 1 (two to be elected):

Charles Walter Bryan, Jr.	4,685
Thorndike Saville	4,683
Scattering	12
Blank	22
Total votes registered	9,402
Total ballots canvassed	4,701

District 4:

Howard Thompson Critchlow	4,685
Scattering	3
Blank	13
	4,701

District 11:

John Haines Gardiner	4,683
Scattering	4
Blank	14
	4,701

District 14:

Harry Freeman Thomson	4,683
Scattering	2
Blank	16
	4,701

District 15:

Oscar Henry Koch	4,684
Scattering	2
Blank	15
	4,701

Ballots canvassed	4,70
Ballots withheld from canvass:	
From members in arrears of dues	8
Without signature	68
Total withheld	
Total number of ballots received	4,77

Respectfully submitted,

FRANK L. GREENFIELD, *Chairman*
DAVID G. BAILLIE, JR., *Vice-Chairman*

E. L. Pavlo	Bertalan Schoen	Louis Goodman
Joseph Farhi	G. L. Freeman	Alfred M. Wym
Howard Holbrook	Theodore P. Kilian	
Jacob Mechanic	C. P. Melioransky	

Tellers

Society's Ninety-Second Year

Extracts from Annual Report of Board of Direction for 1944

THIS Annual Report recounts new programs undertaken by the Society, largely in fields other than primarily technical. Technical meetings were curtailed, and the Annual Convention was dispensed with, except in nominal form. On the other hand more matters of a broad character were instituted, in some instances in close collaboration with the other large engineering societies.

COMMITTEE ON DEPRECIATION

One technical activity deserves particular comment—namely, that of the Special Committee on Depreciation, appointed to present from the engineering approach, rather than from that of the accountant, the problem of depreciation and the resulting effects on utility rates. Copies of both [of its] reports and of the discussions were forwarded to all the members of the National Association of Railroad and Utilities Commissioners with the request that they be considered in connection with the 1943 report of the Committee on Depreciation of that Association. It is significant to note that the Association, at its Annual Meeting held in November, gave no definite approval to either the 1943 or a new 1944 report of its Committee, leaving decision open for further consideration.

POSTWAR CONTROL OF GERMANY AND JAPAN

The President of the Society, together with the presidents of the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Institute of Chemical Engineers, submitted two letters, signed jointly, one to the Secretary of State and the other to the Administrator, Foreign Economic Administration, proffering the services of the 75,000 or more members of their several organizations in helping to solve the problems related to the demilitarization of Germany and Japan. Each letter was accompanied by a statement of essential economic and technological controls that would leave to Germany, or to Japan, an industrial development adequate for peacetime living but inadequate, if policed properly, for the making of war.

In a letter dated December 28, addressed to President Pirnie, Secretary of State Stettinius welcomed the type of participation and aid offered to be undertaken and enclosed a memorandum in which the Engineers' Joint Conference Committee was invited to prepare studies and proposals bearing upon the industrial disarmament of aggressor states.

COLLECTIVE BARGAINING

The Board's recommendations to the Local Sections relative to collective bargaining have been that in each Section there be formed a "Group" of professional engineering employees from whom would be elected a Committee on Employment Conditions. The principle function of these local committees is to be alert to efforts being made to organize professional engineering employees into the major labor organizations and, by making efforts to negotiate and conciliate employer-employee difficulties, to diminish the probabilities of organized labor's entrance into the field of professional engineering. In accord with recommendations of the Board in 1943, thirty Local Sections amended their constitutions to organize such committees and, upon advice of the Board resulting from experience in 1944, several Local Sections are considering creation of Committees on Employment Conditions without amendments to their constitutions.

During 1944 the Board has received petitions from 1,778 persons, calling upon the Board to subject its recommendations to a referendum of the Corporate Membership. These requests have been thoroughly discussed and decision has been made against submitting the subject to referendum as requested. Acknowledgment has been made to each of the petitioners, giving the Board's reasons for declining to act as petitioned.

Legal assistance has been provided, as a friend of the court, to one group of professional engineering employees, many of whom are members of the Society, endeavoring to establish its rights to organize its own bargaining unit.

ECONOMIC STATUS OF THE ENGINEER

Because of interest shown by some of the other Founder Societies in the effect of recent labor legislation upon the profession, the Society has joined with the American Society of Mechanical Engineers and the American Institute of Electrical Engineers in composing and supporting financially a committee established to study the economic status of the engineer.

The joint committee plans to have a manual dealing with existing labor legislation, and interpretations of it made by administrative boards, ready for distribution early in 1945. Also, it is instituting two forms of questionnaire, one addressed to employers, and the other addressed to employees, designed respectively to reflect the policies of employers in their employment of engineers and the economic status and progress of such employees.

PLANNING FOR POSTWAR CONSTRUCTION

Intensifying the efforts made in 1943 by the Society's Committee on Postwar Construction to promote the present planning of postwar construction, three persons were added to the Staff in April 1944. It has been the function of this group, first, to bring about the appointment of committees in each of the 64 Local Sections of the Society. A second function has been to bring about general recognition of the need for planning now for both public and private construction. Another function has been to make known effectively the progress being made throughout the country in bringing actual plans into existence.

Recently this need for construction projects to absorb some of the demobilized men has been recognized by the Committee for Economic Development, and it has established Advisory and Action Committee No. 20, of which President Pirnie is chairman. The Society's Committee on Postwar Construction, and the staff assembled for it, will constitute this new C.E.D. Committee.

SALARY REPORT

The Board gave its approval at its July Meeting to a new Classification and Compensation Plan for Professional Civil Engineering Positions. It establishes general specifications for nine professional civil engineering grades in terms of definition, duties, and minimum requirements. For each grade there is a recommended minimum range of annual salaries.

The Plan states clearly that the recommended classifications should be used with judgment and discretion as to their applicability or adaptability to local situations and sectional variations, which naturally exist in an area that is national in extent.

WEST COAST FIELD SECRETARY

To provide closer contacts between the Society and its members in all its operations—publications, junior forums, Student Chapters, Local Sections, salaries, collective bargaining, professional practice; technical committees, and all other activities in which the Society seeks to be of service to its members—Mr. Henry L. Thackwell was appointed Field Secretary on August 17, 1944. He was assigned to the area consisting of the eleven western states and Texas. Thus, this year, for the first time, the full-time services of a staff member have been devoted to a specific portion of the country to personalize the Society and its work directly to the members resident in a given area.

MEMBERSHIP OF TECHNICAL DIVISIONS

City Planning	883
Construction	4,853
Engineering Economics	1,088
Highway	2,208
Hydraulics	2,606
Irrigation	704
Power	905
Sanitary Engineering	1,730
Soil Mechanics and Foundations	2,344
Structural	4,050
Surveying	1,555
Waterways	904
Total	23,830

MEMBERSHIP AND FINANCES

Two notable events relating to the membership and finances marked the year 1944. First, the Society's membership for the

first time passed the 20,000 mark, its membership at the close of the year being 20,433, a net increase during the year of 1,003. Second, the Society's income available for current operations for the first time passed the half-million mark.

Incident to both of these events is another. The Society has canceled the 1944 dues of 984 members in the armed services who have the rank of captain in the Army or of senior lieutenant in the Navy, or who have lower ranks in the armed services.

Total income received during the year, and thus available for the various operations of the Society, was in the ratio of $1.61 to each $1.00 collected in dues.

READING ROOM OF THE SOCIETY

The registered attendance at the Reading Room during the year was 1,509.

One hundred and ninety-seven periodicals are regularly received. Included in this number are many foreign periodicals, also a number of literary magazines and daily newspapers.

STUDENT CHAPTERS

The total number of Student Chapters remains the same as last year—123.

Life Memberships Awarded

ON JANUARY 1, 1945, a number of Society Members became Life Members and thus exempt from the further payment of dues. This is in accordance with the constitutional provision applying to those who are 70 years of age and have paid dues as corporate members for 25 years, and to those who are less than 70 and have paid dues for 35 years.

The notification brought, as usual, a large number of interesting replies. One member commented that it came as a "surprise and something of a shock to realize that this was the situation," and added that the reason for his first joining was "advice from my chief that the Society was the best organization of engineers in the world, and that if I were going to follow a career as a civil engineer I should endeavor to become a member. Since that time I have never regretted accepting his advice."

Similar in tone is the letter from the member who writes, "I take this opportunity of expressing the hope that the Society will be of advantage to others through the future years, as it has been to me." From another: "I have always been proud of my membership in the Society and have felt it a privilege to be in a position even in a small way, to help maintain such a splendid institution. My interest in its welfare will never cease." And still another: "I have benefited greatly from my membership in the Society and a time like this brings a feeling of regret that I was not able to contribute more."

"In tangible benefits," wrote another, "and as a source of inspiration, my membership through the past third of a century has meant a great deal to me, and it is with considerable pride and satisfaction that I look forward to the assurance that these privileges will carry on as usual through the coming years."

Many members express their appreciation of the Society's technical publications. Others, like the following, deal humorously with the subject of "age": "I never expected to reach thirty-five years of membership in the Society, but had expected long before the expiration of this time to have a nice little tombstone. Seemingly, I have been disappointed, but such being the case, I shall continue to be as active as possible in the Society." And "I do not like to think of my age, but am set on continuing to be of service to the Society which I love."

Another member has a slightly different point of view. "While I appreciate and thoroughly understand the general purpose behind the By-Laws of the Society in exempting from dues those who have paid dues for thirty-five years," he wrote, "of course the life membership is really for meritorious longevity. So if it is possible for me to do so, I would prefer not to accept the life membership and continue the payment of dues. . . . I do not like to take part in any celebration to receive a so-called Life Membership, which is really an admission that I am 'on the shelf.'"

The complete list of those newly exempted from dues is given here:

MEMBERS EXEMPT JANUARY 1, 1945

Abbott, Hunley
Adams, Charles Robert
Allen, Chester Salisbury
Allen, Harold Dayton
Allport, James Hobart
Anderberg, Edward
Anderson, Edward Stewart
Averill, James Leland
Ayer, Frederic Eugene
Bake, William Sibson
Barnes, Frank William
Barrett, Robert Edward
Batchelder, Benjamin Franklin
Bates, John Schuyler
Baton, George Scott
Becker, Elvin Jay
Belzner, Theodore
Benham, Webster Lance
Bevan, Lynne John
Bingham, Clarence Arminger
Black, Ernest Bateman
Blanchard, Arthur Clarence Douglas
Boyd, Walter Lacy
Brooks, Walter Thompson
Brown, Robert Huse
Bruce, John Augustus
Bruntlett, Eugene Harry
Burke, Ralph Haney
Burroughs, Frederic
Busse, Frank August
Case, George Wilkinson
Chamberlin, William Daniel
Chittenden, Albert Frederick
Clark, Arthur Edward
Clark, Arthur Pierson
Collins, Francis Winfield
Comstock, Harold Dearborn
Cowie, Frederick William
Crowe, Francis Trenholm
Curfman, Lawrence Everett
Cushing, Bruce Lincoln
Cutler, Alvin Sayles
Daly, David Augustus
Dambach, William Nicholas
Day, William Peyton
de Moll, Carl
Dickinson, William Dewoody
Diehl, David Leslie
Disbrow, Clarkson Alcott
Dow, William Greer
Dozier, Melville, Jr.
Duncan, Frank Keys
Duncan, James Harper
Dunlop, Samuel Campbell
Dygert, Harry Isaiah
Edwards, Dean Gray
Ellis, Theodore Horatio
Fertig, Jerome Henry
Filley, Oliver Dwight
Fitzgerald, Walter Lewis
Fitzpatrick, James Raymond
Ford, Howard Carlton
Foss, John Harrison
Garrigues, Henry Haydock
Garver, Neal Bryant
Gibson, James Edwin
Goldsmith, Clarence
Grant, Joseph Alexander
Green, Theodore
Gunther, Charles Otto
Guttridge, James Addison
Hale, Hugh Ellmaker
Hale, Richard King
Hall, Hubert Harry
Hall, Warren Esterly
Hanavan, William Lawrence
Hanley, William Scott
Harris, Frederic Robert
Harvey, Clarke Kennerley
Haselwood, Fred Willis
Hastings, Edgar Morton
Hayden, Arthur Gunderson
Hays, David Walker
Hays, Donald Symington
Henderson, Henry Banks
Hickman, Harry Anderson
Hidinger, Leroy Lemayne
Hilts, Harold Ezra
Holbrook, Winfield
Holmes, Lemuel
Hood, Hugh Kendall
Hood, James Henry
Hoover, Herbert
Howard, Edward Henry
Howe, Harry Northrop
Howe, Walter Clark
Howie, Howard
Howland, Lewis Abner
Huber, Walter Leroy
Hutchins, Edward
Hutchinson, Frank
Ibarra Cerezo, Jose Maria
Ives, Howard Chapin
Jacobsen, Hans Peter Rude
Jacobson, Alfred Leon
James, Merton Earle
Jones, Jonathan
Kays, Marion Reed
Kempkey, Augustus
King, Horace Williams
Klein, William Ignatius
LaBach, Paul Mayer
Lanagan, Frank Ray
Law, Walter Hills
Layng, Frank Rahn Shunk
Lewis, Otis Furman
Lockwood, Richard John
Long, Clarence Burton
Lush, Cuyler Warfield
McAlpine, William Horatio
McMenimen, William Vincent
McNeil, Arthur James
Mayne, Joel Harlan
Means, Howard Chester
Merrill, Ferrand Seymour
Miller, Arthur Barrett
Mitchell, Louis Adolph
Morgan, Arthur Ernest
Moritz, Ernest Anthony
Morse, Walter Levi
Mosley, Earl Louis
Munson, John Gephart
Nagel, John
Newell, Robert J.
Newhall, Henry Lester
Newton, John Parsons
Nicolaysen, Albin Georg
Nolen, William Isaac
O'Brien, Daniel Bernard
O'Neil, Joseph
Paget, John Portman
Parsons, Augustus Taber
Peters, Frederic Hatheway
Philbrook, Lee Elmo
Plummer, Horace Edwards
Pritchard, John Charles
Quimby, John Herman
Raider, Harry Adam
Randolph, Robert Isham
Randorf, Charles Andrew
Rapalje, de Witt
Rice, Guy Wickliffe
Rice, John M.
Rich, Melvin S.
Richmond, Jackson Litton
Rights, Herbert Timothy
Ritter, Rollin
Roach, James Howard
Roberts, William Williams
Robinson, Edgar Franklin
Robinson, Ernest Franklin
Rogers, Augustus Webster
Ryan, Walter Jackman
Saucedo, Vicente
Saunders, Walter Bowen
Schermerhorn, Harvey Obed
Schindler, Andrew D.
Schulz, Walter Frederick
Seaver, Clifford
Shaw, George Herbert
Shoecraft, Ezra Collin
Slocum, Harry Spencer
Smith, Chester Alexander
Smith, Donald David
Smith, Karl Garthwaite
Sommer, Albert
Soule, Edward Lee
Spencer, Frank Norton
Stanton, Wilbor Dickens
Strickler, Thomas Johnson
Suarez y Cordoves, Patricio Andres
Swendsen, Warren G.
Swigart, Sherman George
Taylor, Edward Ballinger, Jr.
Tinkham, Ralph Russell
Tompkins, Charles Hook
Tracy, John Clayton
Travilla, James Coxey
True, Albert Otis
Trumpour, Frederick James
Voshell, James Theodore
Waddell, Charles Edward
Waite, Donald Cramer
Walker, Emery Lafayette
Ward, Walter
Warlow, Adoniram Judson
Weinstock, Harry Herschel
Weir, Max Wakeman
Wells, Francis Spinner
Wheat, George Neville
Whitbeck, Lee Field
Whitsit, Lyle Antrim
Whittier, Thomas Tupper
Williams, Enrique Ruiz
Winslow, Carlile Patterson
Woermann, Frederick Christian
Yeo, William Herbert Watt

Developing Professional Status

Report of Committee on Professional Objectives, Indiana Section

FOR SOME TIME the Society, through its Committee on Professional Objectives and in its Local Sections, has been concerned with the status of engineering as a profession. The various topics considered have been membership and membership qualifications, placement, employment service (in some areas placement offices have been maintained), subprofessional work, salaries (job analyses have been made and salary scales have been published), ethics, professional degrees, licensing, improvement of the social position of the engineer, and recognition by the public.

The main objectives seem to be to improve the social, economic, and professional status of the engineer and to establish the engineer as a professional man in the eyes of the public along with the lawyer, the doctor, and the clergyman. The basis of professional standing is public opinion, and progress cannot be made unless the public is convinced that a higher status is merited. In other words, the engineer must earn it and convince the public he has earned it before he can expect recognition.

Various reports have urged group action, enforcement of registration laws, and favorable publicity, but none of these do much good unless back of them all is the merit of the individual engineer. The public's appraisal of the technical training and ability of the engineer fixes his professional status; and his character, personality, and interest in public welfare establish his social position.

College graduates are generally well prepared technically but are woefully unprepared socially. Many are completely unaware of the social problems with which they are confronted. They have the ability to outline and analyze technical problems but are unable to apply this ability in the social or economic field. We are found wanting when we should have clear vision and the ability to propose rational solutions of these problems. First, we do not have the background, the vocabulary, the elements of sociology, and second, we do not realize that, while only one solution is possible in a technical problem, two or more are often obtained in a social problem.

This means a broadening of the educational background of the engineer. In many colleges, curricula are being revised to meet the objectives of the Society for the Promotion of Engineering Education:

1. Understanding of the evolution of the social organization within which we live and of the influence of science and engineering on its development.
2. Ability to recognize, and to make a critical analysis of, a problem involving social and economic elements, to arrive at an intelligent opinion about it, and to read with discrimination and purpose toward these ends.
3. Ability to organize his thoughts logically and to express them lucidly and convincingly in oral and written English.
4. Acquaintance with some of the great masterpieces of literature and an understanding of their setting in, and influence upon, civilization.
5. Development of moral, ethical, and social concepts essential to a satisfying personal philosophy, to a career consistent with the public welfare, and to a sound professional attitude.
6. Attainment of an interest and pleasure in these pursuits and thus of an inspiration to continued study.

It is now recognized that attributes such as character, initiative, resourcefulness, personality, culture, social consciousness, and the ability to get along with and handle men are as necessary as technical competence. Culture comes from within but it can be acquired by a study of the elements that tend to produce it and by association and contact with those who already possess it. Without culture one cannot command the respect that should be accorded a professional man.

The engineer must become better informed on public affairs, and he must be prepared to participate in public problems if he wishes public recognition. In every profession there is an implied obligation to public service both by individuals and by the profession as a whole. However, publicity and public service are not enough. They must be reinforced by competence, which can only come with knowledge. What the colleges are doing in preparing their students, the graduates must do on their own. Reading and study in the fields of history, psychology, economics, sociology, and politics are necessary if we wish to acquire competence in these fields. Once one has acquired a vocabulary and a working knowledge of a field, further study comes much more easily. The committee feels that the Indiana Section should consider a series of programs which are social and humanistic rather than technical in their nature. By this means we could develop an interest in such matters and could work out a reading program that would be of real educational value.

R. B. WILEY, M. Am. Soc. C.E.
Chairman, Committee on Professional Objectives, Indiana Section

Enlargement of Committee on Student Chapters

IN ITS constructive report submitted to the January meeting of the Board of Direction, the Society Committee on Student Chapters suggested changes in the administration of its work by the enlargement of the Committee. This idea was endorsed by the Outgoing Board and confirmed by the Incoming Board with provision of the necessary funds.

For some fifteen years the Committee has consisted of four general members plus one contact member from the Board. During this period the number of Chapters has increased from 93 to its present 123. The work has correspondingly increased, with the result that the Committee now finds it needs to expand in keeping with the demands of this important Society activity.

Specifically, it recommended that one more general member be added, enlarging the Committee from five to six; and that correspondingly the distribution of responsibility be changed into five geographical areas to be known as the Western, North Central, Southern, Middle Atlantic, and Northeastern Regions. As adopted by the Board, this setup then provides for inclusion of the following states in their respective areas:

Western Region		
Washington	Montana	New Mexico
Oregon	Wyoming	Texas
California	Colorado	Arizona
Nevada	Utah	Idaho
North Central Region		
North Dakota	Minnesota	Illinois
South Dakota	Iowa	Michigan
Nebraska	Missouri	Indiana
Kansas	Wisconsin	
Southern Region		
Oklahoma	Kentucky	Virginia
Arkansas	Tennessee	North Carolina
Louisiana	Alabama	South Carolina
Mississippi	Georgia	Florida
	Dist. of Columbia	
Middle Atlantic Region		
Ohio	Delaware	Maryland
West Virginia	Pennsylvania	New Jersey
Northeastern Region		
Maine	New Hampshire	Rhode Island
Vermont	New York	Connecticut
	Massachusetts	

During the past year F. W. Stubbs of Rhode Island State College has been chairman of the Committee. With his retirement, he is being replaced by Prof. Emil A. Gramstorff of Northeastern University, Boston, whose regular term of four years will expire in January 1949. To provide for the future five-year cycle, Craig P. Hazelet, Consulting Engineer of Chicago, has also just been appointed, his term to run until January 1950. The new personnel of the Committee then becomes:

REGION	NAME	ADDRESS	DATE TERM ENDS
Western	Ben S. Morrow, *Chairman*	Portland, Oregon	Jan. 1946
North Central	Craig P. Hazelet	Chicago, Ill.	Jan. 1950
Southern	R. A. Marr, Jr.	Lexington, Va.	Jan. 1947
Middle Atlantic	G. Brooks Earnest	Cleveland, Ohio	Jan. 1948
Northeastern	E. A. Gramstorff	Boston, Mass.	Jan. 1949

The new organization of the Committee is expected to expedite its work. Members will have smaller areas to cover and can therefore attend to their various duties better, including visits to the Chapters and close association with the work. The reorganization becomes effective immediately.

Meeting of the Outgoing Board of Direction—Secretary's Abstract

THE BOARD of Direction met at Society Headquarters on Monday and Tuesday, January 15 and 16, 1945, with the following members present: President Malcolm Pirnie in the chair; George T. Seabury, Secretary; Past-Presidents Black and Whitman; Vice-Presidents Agg, Hastings, R. E. Dougherty, and Thomas; and Directors Bakenhus, Boughton, Breed, Burpee, Dickinson, N. W. Dougherty, Edwards, Gamble, Goodrich, Hollister, Lilly, McNew, Rawn, Scobey, Shannon, Tipton, Tolles, Wilson; and Treasurer Trout.

By special invitation, members of the new Board were present as observers, including J. C. Stevens, Ernest E. Howard, Armour C. Polk, Charles W. Bryan, Jr., Howard T. Critchlow, John H. Gardiner, Oscar H. Koch, Thorndike Saville, and Harry F. Thomson.

Annual Report Authorized

Draft for the Annual Report of the Board was presented. After minor correction it was adopted, with authorization for printing and distribution. Excerpts from this report are given in a separate item in these pages.

Approval of Minutes

Records of the Board meetings of October 9–10, 1944, and of the Executive Committee meetings for October 8 and December 14, 1944, were approved as written.

Actions and recommendations of the Executive Committee meeting on January 14, 1945, were acted upon individually and became the actions of the Board.

Society and Board Meetings, 1945

In conformity with the requirements of the Office of Defense Transportation, the Society Convention for 1945 was canceled. It was also decided that no regional or general Society meetings, or Local Sections conferences, would be held. The Board voted to meet in Chicago during April, at which time it would decide on dates and places for its further sessions during 1945. Reference is made to more extended notice elsewhere in this issue.

Revision of Section By-Laws

Changes in the By-Laws of the Sacramento and Syracuse Sections, as proposed by the Sections, were found to be in proper form and so were approved.

Collective Bargaining

Further developments in the matter of collective bargaining were reviewed and various phases were discussed in detail. Because of other avenues that seemed more promising, it was decided to hold in abeyance the issuing of a proposed questionnaire to Local Sections. In other aspects, the Board voted to continue its present general attitude.

Budget for 1945

Various details of the budget came up for discussion throughout the Board sessions. After full discussion, a budget was recommended to the Incoming Board for approval.

Field Services

Reports of the activities of the Washington representatives and of the Field Secretary on the West Coast were presented, discussed, and ordered received.

Division Activities

The Committee on Division Activities reported it had received requests for the establishment of several new technical committees and that these had been approved and assigned to the appropriate Divisions.

Engineering Education

A lengthy report was submitted by the Committee on Engineering Education, recommending the broadening of curricula in their cultural phases, and suggesting specific changes in the apportionment of undergraduate studies. Before final action, the Board decided to circulate this report to engineering institutions for comment.

Professional Conduct

The Committee on Professional Conduct submitted a proposed code of ethics. It was ordered received, for further study and subsequent consideration.

Membership Qualifications

The Committee on Membership Qualifications reported on extensive studies in connection with possible changes in member grades. After full consideration, the Board decided to adopt the recommendation for the establishment of a special Committee on Member Grades. Based on its future report, the Board might then take steps for formal appraisal and comment by the Society members.

The Board also considered and passed on various questions of specific applications for Society membership.

Interest of Juniors

The Committee on Juniors made various recommendations which were adopted by the Board. These aimed at strengthening the work of the committees on employment conditions in the various Sections; extending the period for transfer to Corporate Membership equivalent to that of time in the military services; and keeping Juniors advised of those details of the GI Bill of Rights as it may be applicable to them.

Student Chapters

Recommendations of the Committee on Student Chapters were adopted as follows: eligibility to serve as faculty advisers were extended to all grades of members, including Juniors; composition of the Committee was broadened by dividing the country into five geographical areas with corresponding changes in distribution of Committee membership (see separate item in this section); and appropriate changes in the budget were recommended.

Registration of Engineers

The Committee on Registration of Engineers reported progress, including steps looking toward revision of the definition of "Professional Engineer" because of questions that have arisen in Illinois and Indiana.

Employment Conditions

On presentation of the report of the Committee on Employment Conditions, its activities were approved. The Board adopted policies as incorporated in an official statement appearing on another page, which it ordered to be published for general information. Appreciation was expressed to the Committee and its chairman.

Numerous Committee Reports

Activities of a number of Board Committees were presented, including among others the Committees on Publications, Securities, Salaries, Postwar Construction, Local Sections, and Private Engineering Practice. In each instance the report was received, and actions were taken wherever necessary.

Progress Reports

Interim reports were received on a number of matters, and the status of various activities of the Society and the Board was reviewed at length.

Secretaryship

The Board was in receipt of letter from Secretary Seabury asking that he be permitted to be retired. A Committee was appointed to give consideration to the selection of his successor.

Adjournment

Expressions of friendship and appreciation for the associations on the Board were voiced by all those members whose terms were terminating. Formal certificates evidencing these activities were distributed. The Outgoing Board then adjourned its final session at 5:00 p.m., January 16.

Meeting of Incoming Board of Direction—Secretary's Abstract

THE INCOMING Board of Direction met at Society Headquarters on January 18, 1945, with President J. C. Stevens in the chair; and present George T. Seabury, Secretary; Past-Presidents Whitman and Pirnie; Vice-Presidents R. E. Dougherty, Thomas, Polk, Howard; and Directors Bakenhus, Breed, Bryan, Critchlow, N. W. Dougherty, Edwards, Gardiner, Goodrich, Hollister, Koch, Saville, Scobey, Shannon, Thomson, Tipton, Tolles, Wilson; and Treasurer Trout.

Expansion—Committee on Student Chapters

Following recommendation of the Committee on Student Chapters, as transmitted through the Outgoing Board, the new Board confirmed the enlargement of the Committee from five to six members, including a contact member of the Board; and took the necessary steps to effectuate this change as explained in another item in this section.

Technical Procedure Committee

Report was received from the Technical Procedure Committee. The Board confirmed immediate necessary appointments to joint committees and took other recommendations under consideration.

Budget Approved

The lists of anticipated incomes and authorized expenditures for 1945 were received, as recommended by the Outgoing Board. After minor revisions, this budget was adopted, covering operations for the coming year.

Committee Personnel

Upon recommendation of the President, the Board confirmed appointments for committees during 1945, as follows:

Society Committees

Acting on the suggestion of the President, the Board approved the following make-up of committees for 1945:

EXECUTIVE COMMITTEE: J. C. Stevens, *Chairman;* R. E. Dougherty, *Vice-Chairman;* Ezra B. Whitman, Malcolm Pirnie, and E. E. Howard.

COMMITTEE ON HONORARY MEMBERSHIP: J. C. Stevens, *Chairman;* Ezra B. Whitman, Malcolm Pirnie, R. E. Dougherty, Franklin Thomas, E. E. Howard, and A. C. Polk.

COMMITTEE ON DISTRICTS AND ZONES: Franklin Thomas, *Chairman;* R. E. Bakenhus, Raleigh W. Gamble, William D. Shannon, and O. H. Koch.

COMMITTEE ON PROFESSIONAL CONDUCT: Fred C. Scobey, *Chairman;* Raleigh W. Gamble, Charles F. Goodrich, Frank C. Tolles, Royce J. Tipton, and Thorndike Saville.

COMMITTEE ON PUBLICATIONS: N. W. Dougherty, *Chairman;* Fred C. Scobey, S. C. Hollister, Wilbur M. Wilson, and H. F. Thomson.

COMMITTEE ON MEMBERSHIP QUALIFICATIONS: Dean G. Edwards, *Chairman;* Charles B. Breed, Gail A. Hathaway, William D. Shannon, Howard T. Critchlow, and John H. Gardiner.

COMMITTEE ON SOCIETY RELATIONS: R. E. Bakenhus, *Chairman;* Dean G. Edwards and Charles W. Bryan, Jr.

COMMITTEE ON DIVISION ACTIVITIES: R. E. Dougherty, *Chairman;* E. E. Howard, *Vice-Chairman;* N. W. Dougherty, Frank C. Tolles, and Royce J. Tipton.

COMMITTEE ON LOCAL SECTIONS: Fred H. Rhodes, Jr., *Chairman;* Lloyd D. Knapp, Robert M. Angas, John B. Babcock, 3d, and Wilbur M. Wilson, *Contact Member.*

COMMITTEE ON JUNIORS: Dana E. Kepner, *Chairman;* Thomas M. Lowe, Edward E. Lustbader, Edmund Wilkes, Jr., and John Gardiner, *Contact Member.*

COMMITTEE ON STUDENT CHAPTERS: Ben S. Morrow, *Chairman;* R. A. Marr, Jr., G. Brooks Earnest, E. A. Gramstorff, C. P. Hazelet, and Harry F. Thomson, *Contact Member.*

COMMITTEE ON ENGINEERING EDUCATION: Ivan C. Crawford, *Chairman;* William J. Shea, Clarence L. Eckel, Harold E. Wessman, Charles A. Mockmore, William J. Armento, and Franklin Thomas, *Contact Member.*

COMMITTEE ON REGISTRATION OF ENGINEERS: T. Keith Legare, *Chairman;* Robert H. Craig, Harold G. Sours, George M. Shepard, H. T. Person, and N. W. Dougherty, *Contact Member.*

COMMITTEE ON PRIVATE ENGINEERING PRACTICE: John W. Cunningham, *Chairman;* Clarence McDonough, L. H. Nishkian, Carlton Proctor, Alfred J. Ryan, Eugene W. Robinson, and E. E. Howard, *Contact Member.*

BOARD OF DIRECTION FOR 1945 AT ITS FIRST MEETING ON JANUARY 18

At near end of table, President J. C. Stevens, center, flanked by A. C. Polk, Vice-President, Zone II, on the right, and E. E. Howard, Vice-President, Zone III, on the left. Continuing clockwise around the table, Thorndike Saville, Director, District 1; C. W. Bryan, Jr., Director, District 1; O. H. Koch, Director, District 15; Frank C. Tolles, Director, District 9; R. E. Bakenhus, Director, District 1; Dean G. Edwards, Director, District 1; stenotypist; Fred C. Scobey, Director, District 13; Wilbur M. Wilson, Director, District 8; Malcolm Pirnie, Past-President; R. E. Dougherty, Vice-President, Zone I; Ezra B. Whitman, Past-President; C. B. Breed, Director, District 2; N. W. Dougherty, Director, District 10; S. C. Hollister, Director, District 3; W. D. Shannon, Director, District 12; Franklin Thomas, Vice-President, Zone IV; C. F. Goodrich, Director, District 6; Miss Frances Sharp, Secretary to Mr. Seabury; George T. Seabury, Secretary; R. J. Tipton, Director, District 16; H. F. Thomson, Director, District 14; H. T. Critchlow, Director, District 4; and J. H. Gardiner, Director, District 11.

COMMITTEE ON SALARIES: Ernest J. Stocking, *Chairman;* E. B. Black, Charles S. Shaughnessy, Sterling S. Green, and C. F. Goodrich, *Contact Member.*

COMMITTEE ON PROFESSIONAL OBJECTIVES: A. C. Polk, *Chairman;* Fred C. Scobey, Thorndike Saville, F. H. McDonald, R. K. Brown, Gordon M. Fair, and Rossiter White.

COMMITTEE ON EMPLOYMENT CONDITIONS: A. M. Rawn, *Chairman;* Richard G. Tyler, William N. Carey, C. W. Okey, and Gail Hathaway, *Contact Member.*

COMMITTEE ON TECHNICAL PROCEDURE: R. E. Dougherty, *Chairman;* N. W. Dougherty, A. C. Polk, Frank C. Tolles, and Royce J. Tipton.

COMMITTEE ON POSTWAR CONSTRUCTION: G. Donald Kennedy, *Chairman;* Adolph J. Ackerman, Charles T. Leeds, Gustav J. Requardt, Frank T. Sheets, E. L. C. Wagner, and Dean Edwards, *Contact Member.*

Adjournment

The Board adjourned to meet in April in Chicago, Ill.

The Engineer in Foreign Service

X. Vacation at an Oasis

By MAJ. ALBERT H. POLLARD, ASSOC. M. AM. SOC. C.E.

Below is part of a letter recently received from Maj. Albert H. Pollard, and taken from the Texas Engineer. At that time he was stationed in North Africa.

WORK HAS BEEN quite consistent and exacting and I was ready for a rest. Fortunately I was able to get a leave of a week, so I departed for an oasis on the northern edge of the Sahara Desert.

Several months ago the U.S. Army requisitioned a hotel, which during the years preceding the war was the finest resort of the type in Algeria. At this place a rest center was established. We were advised to be ready on the particular Saturday morning I left, at 8 o'clock. There were five command cars ready to take the crowd, which consisted of twelve men and eight women. The latter were nurses, WACs and Red Cross girls. There were trailers attached to the cars to carry the luggage.

The first 30 kilometers (18 miles to you) the road was first along the sea and then straight across an intensely cultivated plain growing vegetables and some grapes. We then began climbing and followed a more or less winding course for most of the trip, passing over two principal ranges of hills, between which were beautiful farming sections, some irrigated and some not.

The impression that Africa is a dry, hot, barren place is of course an incorrect one. There are places that are like that, but, just as in Texas, there are many places that are not at all. In this region several crops are raised each year, and even for some distance inland where irrigation is practiced, the arid climate does not prevent production of crops during the dry seasons. On the coastal plain the climate is quite pleasant the year round.

At this particular time, field after field of dark green rye, oats, and barley presented a beautiful vista. The grain was almost mature but still not yellowing at all. Generally interspersed with the green of the grain, there are the lighter shades of green of the vineyards and occasional orchards of citrus, almonds, and olives giving a contrast. Here most of the vines are pruned severely to form individual stubby trunks not unlike a dwarfed tree with gnarled branches such as one finds near the timber line in our Rocky Mountains. These stumps are usually about two feet high. In the spring the new sprouts come out and bear the grapes. Ordinarily the green branches are not over two feet long and are heavily laden with numerous bunches of fruit. Rarely do they train the vines on arbors or along wires in this vicinity, although in Italy and Sicily this method is employed extensively.

The ride through the mountains was very exciting even to one accustomed to the expert manipulation of military vehicles by our soldiers. For quite some distance the road followed mile after mile of sinuous curves. Our drivers knew the road very well and they took each curve at maximum speed. Until one resigned himself to the fact that the man really did know each crook and turn, at each swing it seemed as if possibly the car would not negotiate the turn safely. About forty minutes after we left we passed the commercial bus that left our town about an hour and twenty minutes before our departure. Incidentally, we arrived at our destination about three hours before this bus got there. Of course it stopped for lunch along the way, whereas we had lunch at our destination about 1:30 p.m.

We stopped to stretch a bit at a pass where one could see the Mediterranean about 25 miles distant. The elevation here was almost 2,500 ft. Then we passed into another cultivated section somewhat drier than the first and climbed into another hilly section where we stopped in a nice walled town at an elevation of about 3,000 ft. The natives gathered around to gaze at us and to ask us for "shooin' gum." We gazed back at them and asked them for cokes. That usually stumped them—at least for a few moments, after which they came back with the usual request for cigarettes or "shaw-kalot."

I saw one little Arab girl with a wine bottle of milk and I asked her what she had. She told me it was milk. I asked her if it was cow's milk. She looked at me as if she thought I were sort of peculiar and said, "non, monsieur." Then I asked if it was goat, sheep, or camel milk. She smiled and said that she did not know, probably wondering why anyone should be so inquisitive or critical.

After a few minutes we resumed our trip. We went through a pass at about 3,500 ft and then descended to a high plateau. Here the country was entirely different. The air was dry and the landscape had turned to a khaki brown. Maybe I should be more accurate and state that it was a suntan Sahara color. Soon we saw a few camels on a distant knoll, then we saw an Arab family with about five or six camels loaded with all their possessions. It was the first sight of camels I had had during the sixteen months I had been in Africa. In the following seven days I saw hundreds of them, and soon became very used to them, and even to like them.

The atmosphere began to have an appearance similar to that of West Texas and suddenly I realized I felt different. It hit me all at once that it had been two years since I had been in a dry climate at any great altitude, and that was the reason for "the old familiar feelin'." Both in England and in North Africa I had been constantly surrounded by damp air at a low altitude. I cannot express in words how wonderfully at home I felt, getting back to such a climate. Also I cannot refrain from stating that, although I enjoyed this week's rest, many times this "familiar feelin'" brought to me a greater sense of nostalgia than I have experienced at any time since I left the States. The blue haze on the distant hills and the exhilarating air made me long for our own "hill country." The temperature rose slightly as we progressed southward but the lack of moisture in the air made it seem more pleasant.

We rounded a hill and an oasis struck our eyes. We could not help remarking that it must be a mirage—such a large dark green patch with towering palm trees. Our driver assured us that it was not and pointed out the location of the hotel, a tiny light spot which blended so perfectly with the dunes at its side that we could not at first see it. Within a few minutes it grew in size and the town seemed to jump at us as we came over each small rise.

Soon we were literally roaring into the town, and hundreds of Arabs were waving and yelling greetings at us (no doubt thinking here was a new source of chewing gum, candy, and cigarettes). As we rolled up to the hotel in a cloud of dust, the entire staff lined up in front of the building to welcome us, some turbanned, some with the usual red fez and white robes, and others in G. I. clothing.

At one side were a number of camels resting and chewing their cuds. We gave a quick glance of approval at the setting and scurried in to register and to clean up for lunch, which had been prepared and was ready. There were about 15 guests already there, most of whom seemed to think we might not like the place for some reason and were quick to tell us that it was wonderful and that we were in for a delightful rest. I have some doubt that anyone might have felt that we would not enjoy it, but after that first meal of large, thick steaks and most tasteful accompaniments there was no doubt or disapproval in speech or on faces.

After two years of knocking about, to be waited upon and to have a room in a modern hotel with bath facilities for one's own personal use was a luxury that we had dreamed about many times but did not expect until our return after the war to our country. Another Major and I were assigned to a room, but what a room! It was 15 by 20 ft, with a bathroom 8 by 15 ft. A large double door opened onto a balcony overlooking the front garden.

The dining room was about 35 by 50 ft and the lounge, with bar, was about 25 by 70 ft. In addition the foyer was about 20 by 35 ft. All around were huge windows permitting observation of the gardens, the oasis, and the dunes and distant hills. The dunes commence not over 200 ft from the hotel. The hotel is in a very beautiful setting but what first caught our eyes as we approached it was the large American flag floating in the breeze at one corner of the roof. That was a part of the scenery no one missed.

Recollections of George H. Norman

Of special interest to Society members will be these reminiscences about the late George H. Norman, who was for many years a member of the Society and who established the Norman Medal in 1872. The following excerpts are from "This Was My Newport" by Maud Howe Elliott, daughter of Julia Ward Howe, who has kindly permitted us to reproduce these paragraphs. Acknowledgment is also gratefully made to the Mythology Company, Cambridge, Mass., publishers.

George Norman, the father of Bradford, was the founder of the Newport Water Works. In the early 'seventies, Newport people depended upon wells and cisterns for their water supply. A hogshead stood outside every farmhouse, under a gutter leading from the roof to collect rain water—sovereign for the complexion. From time to time the wells and cisterns had to be cleaned out, at great trouble and expense. Shall I ever forget the day when a leg of mutton, hung down our well at Lawton's Valley, tumbled in—and the to-do that followed? In a dry season, wells were low, and in consequence there was much illness, sometimes even an epidemic. Then came the water giver, Poseidon's high priest, George H. Norman, thanks to whom Newport has its present modern water system. From the beginning a battle royal has raged between the owners of the Water Works and those people who have opposed them. Today, when old animosities are forgotten, George Norman is remembered as one of the strong men of this time. He was born on the first day of the year 1827, and while he traveled widely and left the imprint of his vigorous personality in many distant places, Newport was always his home.

We were among the opponents of the Water Works, as the building of the dam above Oak Glen interfered with our own small, but adequate, system—hydraulic rams which drove the water from the stream to our house. These simple but ingenious devices had been installed by my father first at Lawton's Valley and later at Oak Glen, and if for no other reason it was a bitter day for us when the Norman dam broke and a flood swept through Oak Glen, destroying our own small plant. There followed a long lawsuit concerning the interference with our water supply and our riparian rights. Joseph Coggeshall advised my mother to compromise, but she was a born fighter, and could not follow his advice. In the end, a settlement was made. In spite of the lawsuit, both Mr. Norman and his wife were good friends of ours. I have vivid memories of the Norman household and the nine children, their several pets—among others the youngest daughter's favorite lamb, which grew into a strong-willed ram. He was known to butt visitors he did not like, and once sent a clerical gentleman flying into the hedge.

All properly organized families should have a resident grandmother. Mrs. Norman's mother, Mrs. Kinsley, made her home at "Belair." Her room was the natural refuge of the warring tribe. They brought her all their differences and were ruled by her decisions, for she was the family idol. I can see her now, as she led the way in to dinner on Mr. Norman's arm—a really thrilling figure, with her silver curls, pink cheeks, black velvet and old lace. There are two portraits of her, one by Staigg, and a later full-length one by Frederick Vinton.

George Norman was directly descended from William Bradford, Colonial Governor of Plymouth, and leader of those stern old Pilgrim Fathers who conquered a wilderness and founded a state. When I first met Norman he was a virile, energetic man, although his beard was already gray. It is remembered that when he was a mere child at a dame-school, when the other children gathered to play, George preferred to go home and work at some of the things he liked to make. He had an artistic bent; there still exists at "Belair" several carved wood figures which show that he might have been an artist had he made art a profession rather than a pastime. As a civil engineer contractor and a man of business acumen, he made a name for himself and a fortune for his family. He is remembered in many distant communities, for he introduced public utilities into forty-two cities. One of his early successful enterprises was the bringing of gas light to Santiago de Cuba. For several years, Mr. Norman was one of the editors of the *Newport Daily News*. He was often called to Boston, where at one time he owned a house on Beacon Street; at other times he kept a room at the Parker House. The name of this strong builder is kept alive today by the George Norman Medal of the [American] Society of Civil Engineers, awarded annually to a member of the Society. In a letter to Bradford Norman, Jr., Richard W. Hale writes: . . . ."I dined a couple of days ago with Mr. Justice Oliver Wendell Holmes, over ninety years old, but young as ever. He talked about various people, and I thought your family would be interested in a word that he said:

"'Another man about whom I felt romantic was Norman, the old man who promoted water companies. I met him at the Parker House, and he found a place for me at his usual table. Then later I found a place for him at my table, and we got on finely together. . . . . I remember his funeral. He was carried up the aisle on the shoulders of his six sons. I always had a feeling of romance about him. . . .'"

Interesting figures, those six sons. They all enlisted in the Spanish War, and two fought in the World War.

Society Meetings to Be Omitted in 1945

As IN the past, the Society will cooperate with all national efforts looking toward the conservation of travel facilities. Specifically, it will meet the desires of the Office of Defense Transportation by omitting all official gatherings during the remainder of the year. Plans for the Annual Meeting, January 17–19, 1945, had already been completed before receipt of the urgent request that such gatherings be canceled. Incidentally, a report on this January Meeting will be found elsewhere in this section.

By decision of the Board of Direction, which met just before the Annual Meeting, all official gatherings of the Society during the remainder of the year are to be called off. These include the Convention ordinarily held in July, the Spring and Fall Meetings of the Society, and all Local Section conferences.

As regards meetings of the Board itself, decision has been deferred. It was voted that the Board would hold its usual April meeting, set for Chicago, Ill., and at that time would determine the number and location of its subsequent meetings during the rest of the year.

In making these decisions, the Society is acting in full accord with the desires of the Office of Defense Transportation, under J. Monroe Johnson, M. Am. Soc. C.E., its Director.

News of Local Sections

Scheduled Meetings

CLEVELAND SECTION—Dinner meeting at the Cleveland Engineering Societies Club on February 16, at 6:30 p.m.

DAYTON SECTION—Luncheon meeting at the Engineers' Club on February 19, at 12:15 p.m.

GEORGIA SECTION—Luncheon meeting at Davison's Tea Room on February 2, at 12:30 p.m.

IOWA SECTION—Conference at the Hotel Fort Des Moines preceding the annual meeting of the Iowa Engineering Society on February 6, at 9:30 a.m.

METROPOLITAN SECTION—Technical meeting at the Engineering Societies Building on February 21, at 8 p.m.

MIAMI SECTION—Dinner meeting at the Wonder Grill on February 1, at 7 p.m.

NORTHWESTERN SECTION—Dinner meeting at the Campus Club on February 5, at 6:30 p.m.

PHILADELPHIA SECTION—Social meeting at the Engineers' Club on February 17, at 6 p.m.

SACRAMENTO SECTION—Regular luncheon meeting at the Elks Club every Tuesday at 12 m.

ST. LOUIS SECTION—Luncheon meeting at the York Hotel on February 26, at 12:10 p.m.

SAN FRANCISCO SECTION—Dinner meeting at the Engineers' Club of San Francisco on February 20, at 5:30 p.m.

TEXAS SECTION—Luncheon meeting of the Dallas Branch at the Adolphus Hotel on March 5, at 12:15 p.m.; luncheon meeting of the Fort Worth Branch at the Blackstone Hotel on February 12, at 12:15 p.m.

TRI-CITY—Dinner meeting at the Mississippi Hotel on February 15, at 6:30 p.m.

Recent Activities

CENTRAL ILLINOIS SECTION

An illustrated talk on building construction in South America was the feature of the December meeting of the Section, held in Urbana on the 5th. This was given by A. J. Boase, manager of the Structural Bureau of the Portland Cement Association, who based his comments on a recent trip to Brazil, Argentina, and Uruguay. New officers elected during the session are as follows: H. A. Spafford, president; T. C. Shedd, first vice-president; L. E. Philbrook, second vice-president; and Ralph B. Peck, secretary-treasurer.

CLEVELAND SECTION

Modernization of Ohio's trunk highways was urged by Harold G. Sours, Ohio State Highway Director, at the December 15 meeting of the Cleveland Section. Mr. Sours gave a comprehensive outline of the state's highway needs and postwar plans, revealing that the highway department already has plans for $27,000,000 worth of postwar projects, with another $25,000,000 in the making. In addition to the modernization of trunk-line routes, major needs include the development of expressways in the cities, adequate parking facilities, and improvement and expansion of farm-to-market roads, he pointed out.

COLORADO SECTION

At the annual meeting of the Section—held in Denver on December 11—the following new officers were elected for the coming year: B. W. Matteson, president; J. E. Warnock, vice-president; and R. W. James, secretary-treasurer. The technical program consisted of a talk by Maj. Claude Bonham, a physician of Boulder, Colo., who has been on active duty with an Army field hospital unit in North Africa, Sicily, and Italy, and is now convalescing in a veterans' hospital. Major Bonham's subject was "Americans at War," in which he discussed the place of the medical and engineering professions in public health and sanitation. During the evening certificates of life membership were presented to Howard Carlton Ford and to Earl L. Mosley.

DAYTON SECTION

On December 18 members of the Dayton Section enjoyed a discussion on the postwar aims and activities of the Section, with C. H. Shook, president of the Section, leading the discussion. The Section went on record as favoring the adoption of the Ohio Coordinate System. During the evening a certificate of life membership was presented to Arthur E. Morgan, former chief engineer of the Tennessee Valley Authority. Dr. Morgan spoke briefly on some of the problems and experiences encountered in his long engineering career. The following new officers were elected for 1945: Harry S. Price, Jr., president; George T. Neuffer, first vice-president; Ralph L. Woolpert, second vice-president; and W. E. Keyser, secretary-treasurer.

ILLINOIS SECTION

In connection with the annual meeting, which took place in Chicago on December 15, certificates of life membership were presented to Ralph H. Burke, Robert I. Randolph, and James R. Fitzpatrick. Honored in absentia were Clarence Goldsmith and J. T. Voshell. A talk by George T. Horton and the showing of a Coast Guard sound film on the construction and launching of ships on the Illinois and Mississippi rivers comprised the technical program. Mr. Horton, who is president of the Chicago Bridge and Iron Company, spoke on "Shipbuilding on the Illinois," in which he described the construction of LST's at the Seneca shipyards.

KANSAS CITY SECTION

The technical program at the December 8 meeting of the Kansas City Section consisted of talks by two Juniors—Wilbur S. Feagan and Donald L. Flanders. Mr. Feagan, who is an engineer with the Kansas City Health Department, spoke on "Expanding Opportunities for the Civil Engineer," while Mr. Flanders' subject was "Postwar Airline Operations." The annual election of officers held at this time, resulted as follows: Melvin P. Hatcher, president; Clare R. Van Orman and John C. Long, vice-presidents; and Ansel N. Mitchell, secretary-treasurer.

KENTUCKY SECTION

A joint meeting of the Section and the Kentucky Society of Professional Engineers was held in Louisville on December 19. During the business session the annual election of officers was held, with the following results: Wallace W. Sanders, president; A. L. Chambers, vice-president; Charles W. Lovell, secretary-treasurer; and Earl H. Schaaf, corresponding secretary. The speaker of the evening was Harry Thompson, who gave a talk on postwar planning. Later a general discussion on the subject was led by Mark B. Owen, director of the Research and Development Division of the Society.

LEHIGH VALLEY SECTION

"The Status of Postwar Construction" was the topic of discussion at the December 11 dinner meeting of the Lehigh Valley Section, the principal speaker on the program being Mark B. Owen. One feature of the occasion was the presentation of certificates of life membership to H. T. Rights and Jonathan Jones. The new officers for the coming year are H. W. Lawson, president; J. W. Pastorius and H. A. Wistrich, vice-presidents; and M. O. Fuller, secretary-treasurer.

LOS ANGELES SECTION

At the annual meeting, held on December 13, the Section was honored by the presence of sixteen of the nineteen past-presidents of the Section who are still resident in the Los Angeles District. Each of these gentlemen—from Maj. Charles T. Leeds, who was president in 1915, down to Don Hull McCreery, outgoing president—outlined the interesting events of his administration. One of the group, Samuel B. Morris, who was president in 1925, is also past-president of the San Francisco Section. During the evening the following new officers were chosen to lead the Section during 1945: Markham E. Salsbury, president; Claude W. Sopp and Robert Skinner, vice-presidents; Arthur Pickett, secretary; and Sterling S. Green, treasurer.

MARYLAND SECTION

New officers for the Section, elected at the December 14 dinner meeting, are E. W. Digges, president; N. D. Kenney, vice-president; and S. B. Downey, secretary-treasurer. Certificates of life membership were awarded to Harry A. Raider and Frank E. Duncan, the latter in absentia. In accepting his certificate, Mr. Raider reminisced interestingly on his experiences building railroads in China and the Philippines. During the evening it was announced that Gustav J. Requardt, member of the Section and former Director of the Society, has been honored by the American Water Works Association, which bestowed upon him the George Warren Fuller Award at its recent four-state section meeting.

METROPOLITAN SECTION

A symposium on "Wind Stresses in Highway Bridges" comprised the technical program at the January 10 meeting of the Metropolitan Section, the principal speakers being John I. Parcel, consulting engineer of St. Louis, Mo., and Shortridge Hardesty, New York consultant. A discussion, led by O. H. Ammann and D. B. Steinman, completed the program. There was a capacity audience for the December 20 meeting to hear Brehon B. Somervell, commanding general of the Army Service Forces, give a talk on "Current Problems in Army Service Forces." General Somervell discussed at some length the general problems involved in the conduct of the war, which have been solved by the Army Service Forces. These problems include construction, transportation, and securing materials. General Somervell's paper is published elsewhere in this issue.

MID-MISSOURI SECTION

The annual meeting of the Mid-Missouri Section was held in Jefferson City on December 2 in conjunction with the annual

vention of the Missouri Society of Professional Engineers. Speakers at the morning session were S. M. Rudder, assistant chief engineer of the Missouri State Highway Department, whose subject was "Postwar Planning for Missouri Highways"; Ernest E. Howard, Kansas City consultant and newly elected Vice-President of the Society, who discussed current professional engineering problems; and Allen McReynolds, attorney of Carthage, Mo., who commented on the proposed state constitution as it relates to engineering work. The afternoon program consisted of talks by Edward L. Clark, state geologist; Edward M. Stayton, consulting engineer of Independence, Mo.; Sidney L. Stolte, president of the Minnesota Association of Professional Engineers; and Frank X. Meehan, regional manager of the Committee for Economic Development. During the business meeting, held later in the afternoon, the following new officers were elected for the coming year: Wayne S. Frame, president; Garvin H. Dyer, second vice-president; W. J. Schulteen, secretary-treasurer; and John A. Short, Junior director. A dinner dance concluded the all-day session.

MOHAWK-HUDSON SECTION

Speaker and guest of honor at the December meeting of the Mohawk-Hudson Section, which was held at Rensselaer Polytechnic Institute on the 19th, was C. M. Ripley, of the General Electric Company. In a talk entitled "Power for War," Mr. Ripley discussed the versatility of electricity in its capacity to heat, cool, and do all types of work, especially with reference to the war effort. He pointed out, also, its low cost and the great number of materials it has made available at reduced cost that are used in the war effort. An interesting exhibit of such materials, made by the General Electric Company for the war effort, was on display. These included electrically heated aviation clothing, minute electric motors and gear reducers, special electric magnets, magnesium structural shapes, and many other interesting products.

NEBRASKA SECTION

Richard R. Tipton, who built the Peace River suspension bridge and other structures on the Alaskan Highway, addressed the Nebraska Section at a dinner meeting held on December 12. Mr. Tipton, who is now stationed in Kansas City as bridge engineer for the Public Roads Administration, declared that weather conditions confronting our engineers on the construction of the Alaska Highway were as severe as any encountered by our troops on any front. He supplemented his talk with colored motion pictures, depicting the terrain and some of the construction operations on the project, which he had made himself. During the evening a certificate of life membership was presented to John A. Bruce.

NORTH CAROLINA SECTION

The winter meeting of the North Carolina Section took place in Winston-Salem on December 11. Following dinner James E. Jagger, Acting Assistant Secretary of the Society, gave a résumé of the year's activities of the Society and discussed the subject of collective bargaining. A round-table discussion on employment conditions concluded the technical program. During the evening a certificate of life membership was presented to Albert O. True.

NORTHEASTERN SECTION

The two speakers at the November meeting of the Section were Prof. Henry G. Houghton, Jr., and Dr. James M. Austin, both of the department of meteorology at Massachusetts Institute of Technology. Meteorology at home was described by Professor Houghton, who covered storm formation, path of travel, and factors influencing intensity and behavior of storms along our Atlantic Coast. Dr. Austin then spoke on wartime uses of meteorology, describing the uses of weather forecasting as influencing our air-offensive operations, long-range forecasting, and planning of military objectives. An interesting general discussion concluded the program.

OREGON SECTION

A talk by Maj. John Hanson-Lawson, of the British Army, and the showing of an Army war film, "Brief for Invasion," comprised the technical program at the November meeting of the Oregon Section. Major Hanson Lawson described his experiences landing on the shore of Normandy on D-day with the Sherwood Rangers and discussed other experiences that gave a picture of what the war is like. Many developments in the field of engineering were brought out in the film.

PHILADELPHIA SECTION

There was a large turnout for the December meeting, which took the form of a joint session with the Philadelphia chapter of the American Society of Mechanical Engineers, to hear how public utilities perform in wartime. The first speaker was Horace P. Liversidge, president of the Philadelphia Electric Company, who discussed his company's enormous program of expansion to further the war effort. In spite of unprecedented demands for power, no war plant in the Philadelphia area has had to curtail production, and no business, home, or farm in the area has lacked electric power when it needed it, he pointed out. Next on the program was Harry E. Jordan, executive secretary of the American Water Works Association, who discussed public water supply in wartime. In some sections of the country war demands have caused a critical water shortage. In the Philadelphia area, however, an intelligent conservation program prevented such a situation. Unfortunately, according to Mr. Jordan, water supplies cannot be so readily and extensively pooled and interconnected as is possible in the case of power, though some progress has been made in that direction.

PROVIDENCE SECTION

On December 19 the Section held a joint meeting with the Providence Engineering Society. The speaker of the evening was A. D. Hunter, commander, Civil Engineering Corps, U. S. Navy, who discussed the organization and work of the Seabees. Two experts from the Quonset Naval Base then staged a half-hour demonstration of Judo, after which official Navy movies of the construction of artificial harbors in Normandy were shown. Despite a heavy snowstorm, there was an attendance of over a hundred.

ROCHESTER SECTION

The Rochester Section sponsored the first three luncheons of the Rochester Engineering Society for 1944–1945. Speakers for these occasions were Francis H. Carroll, director of public works for Monroe County, who discussed postwar planning for Monroe County; Arthur H. Crapsey, director of the Monroe County Veterans Information Bureau, who described the work of the Bureau; and Alexander Russell, vice-president and general manager of the Rochester and Lake Ontario Water Service Corporation, whose subject was "The Romance of Water Supply." Programs for all three luncheons were arranged by Harry Eustance, who also presided at the luncheons.

SACRAMENTO SECTION

Business at the December 5 meeting included the presentation of diplomas of life membership to Francis T. Crowe, Donald S. Hays, Fred W. Haselwood, Arthur J. McNeil, and Walter Ward. On the 12th, Col. Robert C. Hunter described the expansion of the Sacramento District of the U.S. Engineer Department to a point where it is the largest District in the country, has completed 400 million dollars worth of military construction, and planned nearly as much postwar work for flood control in the Central Valley. The annual Christmas Jinx, on December 19, attracted a record-breaking throng of almost 350 to a program burlesquing the political feud between the U.S. Engineer Department, the U.S. Bureau of Reclamation, and the state for ownership of California's rivers.

ST. LOUIS SECTION

A joint meeting of the Section and the Engineers Club of St. Louis took place on December 7. A talk by A. J. Boase, manager of the Structural Bureau of the Portland Cement Association, Chicago, comprised the technical program. Mr. Boase, who recently returned from a trip to the principal cities of South America, described construction practices of the country, calling attention to the fact that great strides have been made in reinforced-concrete construction. Their engineers are not bound as we are by building codes, he said, and therefore are able to make a radical departure from our more conventional designs.

SAN FRANCISCO SECTION

At the annual meeting of the Section, which was held on December 19, the following officers were elected for the coming year: George D. Whittle, president; T. P. Dresser, Jr., senior vice-president; Sidney T. Harding, junior vice-president; and J. E. Rinne, secretary-treasurer. During the evening certificates of life membership were presented to John S. Bates, William D. Chamberlin, Walter L. Huber, Augustus Kempkey, August T. Parsons, and Edward L. Soule. Certificates were mailed to eight others who

found it impossible to attend. The technical program consisted of the showing of a sound motion picture, "Canol," which depicted the construction of the Canol oil-supply project in Canada and Alaska. The picture was made by Bechtel-Price-Callahan, contractors on the construction of the project, and discussed by the vice-president of the W. A. Bechtel Company.

Members of the Junior Forum met on December 5 to hear Thelo Perrott, chairman of the Section's Interim Committee on Employment Conditions, speak on collective bargaining.

TACOMA SECTION

Speakers at the November meeting of the Section were Maj. Verne L. Watkins, of the Engineer Training Center at Fort Lewis, Wash., and H. J. Oliver, of Seattle. Major Watkins spoke on the subject, "Combat Engineers in the African Campaign," drawing on his personal experiences for colorful stories, while Mr. Oliver explained the Lambert Grid Coordinate System and its application to the state of Washington. Mr. Oliver also described a bill to be presented to the next legislature that would make the system official in the state.

TOLEDO SECTION

Henry E. Riggs, Past-President and Honorary Member of the Society, was guest of honor at the December 11 meeting of the Toledo Section. Dr. Riggs reminisced very interestingly on his early experiences in Toledo, where he lived before joining the faculty of the University of Michigan. A talk by John S. Worley, professor of transportation engineering at the University of Michigan, comprised the technical program for the occasion. Professor Worley gave an illustrated lecture on the subject, "The Antiquity of Things New," showing how many of the mechanical devices and construction practices of our modern world were used many centuries ago. The results of the election of officers for 1945, announced at the close of the meeting, are as follows: John B. Klunk, president; Carleton S. Finkbeiner, first vice-president; Robert E. Brown, second vice-president; and Clair A. Shaler, secretary-treasurer.

TRI-CITY SECTION

"Postwar Highway Plans for Iowa" was the subject of discussion at the December meeting of the Section, which was held in Davenport on the 14th. The principal speaker on this program was C. C. Coykendall, administration engineer for the Iowa Highway Commission, who discussed a broad program for the state, which is expected to extend over a 12 to 15-year period and cost about 638 million dollars. This broad program of highway development is now being studied by the Committee on Highways of the Iowa Postwar Rehabilitation Commission.

VIRGINIA SECTION

The fall meeting of the Virginia Section took place in Roanoke on December 9. E. M. Hastings, Vice-President of the Society, welcomed Student Chapter members from the three engineering schools in the state, who were guests of the Section for the occasion. Later three of these young men—H. L. Kirby, of Virginia Polytechnic Institute; Irwin Brodell, of the University of Virginia; and Jean Edens, of Virginia Military Institute—presented short papers on timely topics. The second phase of the meeting was a business session that followed the dinner meeting. James E. Jagger, Acting Assistant Secretary of the Society, addressed the latter gathering on the subject of the Society's activities. Later there was a general discussion of Mr. Jagger's talk.

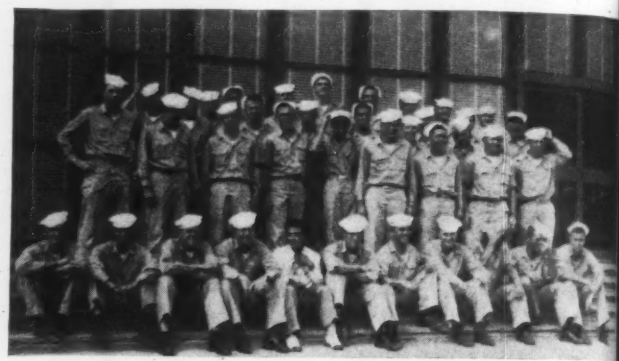
WISCONSIN SECTION

The annual election of officers—held at the December 21 meeting—resulted in the selection of E. L. Roettiger as president; L. D. Knapp, first vice-president; E. H. Schmidtman, second vice-president; and O. N. Olson, secretary-treasurer. During the evening a certificate of life membership was presented to E. L. Walker, who addressed the group briefly. There was a technical meeting in November, at which C. A. Willson, section chief in the Construction Materials Division of the War Production Board, Washington, D.C., spoke. In his talk, which was entitled "Hitting Hitler with Directives," Mr. Willson traced the growth and development of the War Production Board. His explanations of what the Board is trying to do were most enlightening to the group. Mr. Willson is a former president of the Section.

Student Chapter Notes

CALIFORNIA INSTITUTE OF TECHNOLOGY

Members of the Student Chapter at the California Institute of Technology recently visited the Kaiser Steel Plant at Fontana, Calif., where they had an opportunity to inspect the coke ovens, blast furnaces, and rolling mills, and get a general idea of the layout of the plant. The trip, which was sponsored by Prof. R. R. Martel and Dean Franklin Thomas, Vice-President of the Society, proved exceptionally interesting, and the Chapter has already made plans for an inspection trip to the Los Angeles Harbor. The group making the trip is shown in the accompanying photograph, which was taken in front of the Administration Building at the plant.



CALIFORNIA INSTITUTE OF TECHNOLOGY STUDENT CHAPTER
Group Photographed in Front of Administration Building at Kaiser Fontana Plant

UNIVERSITY OF UTAH

The winter-quarter activities of the Student Chapter began with a general meeting on December 19 to discuss the coming Engineering Week. The program outlined called for full participation of the Chapter in all the events. A talk by Prof. Adelbert Diefendorf on "Elective Courses for Civil Engineering Students" concluded the meeting. Professor Diefendorf, who is head of the department of civil engineering and the school of mines at the University of Utah, stressed the importance of selecting elective courses that will be of immediate application to engineering.

MANHATTAN COLLEGE

The Manhattan College Student Chapter reports that it has been having bi-monthly meetings. Outstanding among these gatherings was the meeting of December 13, at which Joseph M. Kennedy spoke on the "Economics of Flood Control." Mr. Kennedy, who is senior engineer for the North Atlantic Division of the U.S. Engineer Office, discussed the measures being taken by the Corps of Engineers of the U.S. Army to prevent floods. The accompanying photograph of the students and faculty attending the lecture was made by Joseph S. Ward, Jr., publicity director for the Chapter.

RECENT MEETING OF THE MANHATTAN COLLEGE CHAPTER
Joseph M. Kennedy, Alumnus and Guest Speaker, Is Second from Right, First Row

ITEMS OF INTEREST

About Engineers and Engineering

Engineers-in-Training

An Innovation of Far-Reaching Significance in the Procedure of Registration of Professional Engineers

By CHARLES F. SCOTT

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This statement was prepared by Dr. Scott for submission to the Connecticut Technical Council, which had been asked for its recommendation as to adoption of the classification of "engineers-in-training" in the registration procedure. Shortly before his death on December 17, 1944, he revised it to the form here printed.

"ENGINEERS-IN-TRAINING," in brief, permits candidates for registration by a state engineering examining board to take part of the examination—that in fundamental engineering subjects—before the completion of the experience period of four years or more; i.e., at any time following graduation from an accredited course (or completion of satisfactory preliminary experience). To those who pass this examination a certificate is issued; registration then awaits completion of experience and the final examination.

The foregoing provision was added to the Model Law, in the 1943 revision, which is endorsed by leading engineering societies for adoption by the several states. The National Council of State Boards of Engineering Examiners, at its 1944 annual meeting, recommended to state boards favorable consideration of the "engineers-in-training" program.

New York changed its rules and inaugurated "engineers-in-training" in 1943. There have been three examinations, at each of which approximately 60% of 60 candidates passed. Iowa has likewise modified its rules. Ohio has changed its law, effective in 1946, to provide for "engineers-in-training" and the examination of all candidates. Georgia, Minnesota, and Missouri are making necessary provision by changes in law or rules, and seven other states are actively considering provision for "engineers-in-training." "Engineers-in-training" is a part of the engineering profession in certain of the provinces in Canada.

The new plan, involving the preliminary examination, portends much more than a mere rearrangement of examination schedules; it is significant from many points of view:

1. *"Engineers-in-Training"* aims to vitalize the critical but neglected period, the experience period between graduation and registration. To the student in the engineering school, graduation has been the coveted goal of four years of study; his curriculum has been clearly defined; instructors have been expert guides; the whole environment subserves his progress. After graduation the young engineer must usually find his own way; objectives are vague; there are no specified curricula; environment may be depressing; he finds obstacles and must make detours; guide posts are few and human guides are largely accidental. But when he becomes an "engineer-in-training," he acquires a new and definite goal—registration. His task now is by self-development to qualify as a professional engineer. And as his own aims and efforts become more definite, others may be more ready to guide and aid. The experience period may awaken constructive interest as its significance is better recognized. Formal recognition is now accorded by the "engineers-in-training" category; it is a step in placing the experience period on a new basis.

2. *The Meaning of Experience.* The two examinations, preliminary and final, are of different type. The first, which may be taken immediately after the diploma is received, deals with what has been acquired in the engineering school. This examination may not duplicate those given in specific subjects before graduation, but problems may be of the comprehensive type involving several branches of engineering; emphasis may be laid less on manipulation and more on application; problems relating to actual structures or plants or machines or processes may indicate a shift from "abstract" theory to concrete reality. The final examination following the experience period should ascertain the development during this period of experience. Enlistment as an "engineer-in-training" with credit for the examination in "fundamentals" prompts the query as to what new things should be acquired in the experience period to qualify for the coming examination. Just what is the experience period expected to add to one's capability? Just what kind of experience does the board deem "satisfactory"? It may not be the skill acquired for doing certain things, but rather a by-product of general engineering competency, such as intellectual independence with ability to think and to act without minute direction, facility in handling a problem by analyzing it and understanding what is required and then bringing together the elements for its solution—in short, beginning to practice engineering as an intellectual and not merely a routine process.

3. *A Stimulus to Individual Development.* Contemplation of the difference in character of the two examinations prompts the question as to one's own progress. It clarifies what President Doherty says in portraying "the engineering profession tomorrow" concerning engineering education:

"Intellectual power, not merely routine skills and memorized facts, is the primary end. Acquisition of subject matter without a cultivated method of applying it to practical situations is educational sterility."

As the embryo engineer realizes that knowledge without ability to apply it is also engineering sterility, he gains a new viewpoint as to his own development. He may well question whether his environment and efforts are producing the requisite qualities, or whether change is essential to his proper development.

4. *Incentive to "Professional" Consciousness.* The alert recruit will want to know what are the "professional" aspects of the career in which he has enlisted. He finds that much more is involved than he had realized. Not only must he keep abreast with the advances in his own field, which may call for continual study aided by membership in his technical society and recourse to technical journals, but supplementing technical proficiency there are other qualities which distinguish a professional man, such as basic integrity, standards of conduct based on courtesy, honor and ethics, also a motive for service and a recognition of social duty. These matters now become realistic and personal. A new consciousness is awakened. Then he may come to see that the profession for which he is in training ranks high as an agency in economic progress and social welfare; it challenges his own ideals and efforts.

5. *Collective Bargaining.* Without attempting a discussion in detail, it may be remarked that a certificate from a state board certifying that an important initial step has been taken toward recognition as a professional engineer may have a bearing on the individual's status in collective bargaining. In any event, the possession of the certificate should strengthen the ambition to achieve full professional status.

6. *Aid to Engineers-in-Training.* Registration boards which have had little to do with prospective registrants until formal application for registration is received, may now make known to those formally enrolled what kind of experience they deem satisfactory and indicate the technical and professional capabilities and attitudes which should be developed in the training period. A definite group with a common goal may be aided in their training by their elder brothers. (Often young engineers who are steering their own career may be working hard but up blind alleys; for example, the immediate task may dominate interest and effort to the exclusion of long-range and less tangible objectives.) In New York (where the movement was initiated by a group of young engineers) an organization of "engineers-in-training" is forming which is sponsored by the State Society of Professional Engineers.

7. *A General Stimulus to Professional Development.* The "engineers-in-training" movement, by emphasizing and fostering after-graduation development as essential to competency in professional engineering, may awaken other agencies to their opportunity and responsibility. While much attention is given to undergraduate curricula and training, far too little is directed to the objectives and methods and aids to maturer growth in the after-graduation period. Engineering societies, national and local, individually and collectively, and industries, individually and collectively, may well determine how to increase their interest and efforts in assisting their younger personnel in wholesome professional development. They do not need elevators to raise them to higher levels, but they do need aid in recognizing and reaching the rungs of the ladder on which they must climb.

8. *Engineering Schools and Registration.* Examination soon after graduation by a state board may not merely appraise technical knowledge but it may be a test of breadth, of attainment in engineering method and attitude, and of other qualities which educators proclaim as objectives of college training—in short, its aim is to determine broadly the adequacy of the school training as the foundation for a professional career. Results of the preliminary examination are of vital concern to the engineering teacher as well as to the examining board. If graduates of accredited courses fail in this preliminary test, something is wrong—the accrediting, or the teaching, or the student, or the examination. Fatalities should prompt an inquest. When facts are known, remedies may follow.

Educators will gain new understanding of professional registration; they will inform their students regarding it; they will be alert to prepare their students for it. In short, the preliminary examination should establish close relations between educators and examiners.

9. *Résumé.* Thus the preliminary examination becomes a focal point of many interests in the graduation-to-registration period.

To the bewildered graduate it is clarifying and directive; he gains perspective on his own career as he finds how experience may build competency; and he is inspired by the greatness of the profession for which he is training.

To examining boards the separation of preliminary and final examinations explains the difference between the status of the candidate at graduation and after the years of experience: What should he gain? What has he gained? And what constitutes fair examinations? Furthermore, there is opportunity and implied responsibility for giving helpful information and suggestion to those admitted to training.

To the engineering teacher there may come an immediate appraisal of his graduates. He comes in close contact with registration—"the new development in engineering." He realizes his responsibility in building "the engineering profession tomorrow." Contacts between educators and examiners may lead to mutual understanding and better coordination between the two great stages in the development of the engineer.

To engineering societies and industries there may come a new realization of what they should contribute to the "experience" period in the development of those who are to be their leaders later on. True, they have been doing a good job here and there, but it is spotty. The problem has been treated as local and incidental. But it is universal and vital. Difficulties are challenging in normal times; they are intensified by the war upset. Can they meet the challenge now?

N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. AM. SOC. C.E.

POSTWAR PLANNING was polite table talk at the Engineers Club until Mac McMack bragged that all his plans were blueprinted and frozen. Titus Wadhouse challenged, "Bet you lose two-thirds of them in the thaw and have to redesign the other third. One per cent for design is all right for wartime extravagance, but not for peacetime economy."

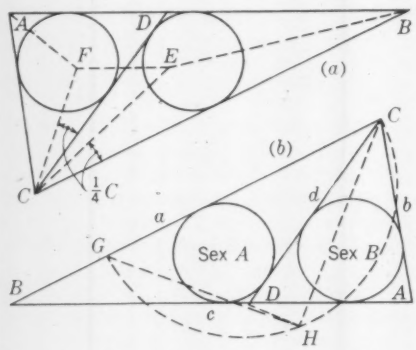

FIG. 1. PRISSYVILLE POSTWAR PUBLIC POOLS

Ken Bridgewater said he was glad he had half his plans carefully done, because the war was going to last another year anyway. "Tho' a skeptic, I'm neutral, so I'll hold the bets," interrupted the Professor, but the Scots weren't betting money. "That being settled," he continued, "let's listen to our Guest Professess, Ann Othernut, and her Prissyville Postwar Pool Problem."

"Prissyville couldn't wait, Noah," replied Ann. "The pools were finished yesterday and frozen this morning. The question is how Al E. Dayde divided the triangular lot so that equal circular pools could be dug in each part."

"Using only transit and tape," finished Joe Kerr. "If that means Euclidean construction plus a surveyor's wiggle, I'll tell you my cut-and-try solution."

"No, no wiggles," replied Professess Othernut, "but I concede that transit and tape will serve perfectly for straightedge and compass."

"I didn't need the tape," said Sir V. Ayer, stepping up to the blackboard (Fig. 1*a*). "From *E*, on the bisector of *B* and the quadrisector of *C*, turn parallel to *BA* and cut the bisector of *A* at *F*. From line *CF* deflect by one-fourth of *C* and you are looking right down the fence-line *CD*."

"Can you prove it?"

"I'll try if you'll disprove it first!"

"I have a sure way," said Cal Klater. "On *CG* (Fig. 1*b*), equal to $\frac{1}{2}(a+b)$, erect semicircle and make chord *GH* equal to $\frac{1}{2}c$. With *C* as a center, draw arc *HI* intersecting *AB* at the required fence corner. Then $4d^2 = (a+b)^2 - c^2$, which is the condition implied by the problem. By the way, does S.P.M.B. stand for the Society for the Promotion of Modest Bathing?"

"No, the Society for the Prevention of Mixed Bathing, Cal. But your solution is perfect—just as I did it and as Lynne Bevan did it. Guess that's all, Noah."

"And a pretty problem, Ann. Apropos of Sir V's solution, I computed the tangent of angle *ACD* for a 90-30-60° triangle and found $\frac{1}{2}\sqrt{2} = 0.707$, compared with $\frac{1}{11}(6+\sqrt{3}) = 0.703$ by his method. That would have satisfied the selectmen and the S.P.M.B.

"Incidentally, the selectmen drew the fence from vertex *A*, but Al told them the area of the two pools would be 28% less than one large pool inscribed in the whole lot. Al ran his fence from vertex *B* so that the area of the two pools is now 28% more than one large pool would have been. Each side of the lot is an integer; if one is 400, what are the two others?"

[List of Cal Klaters will be given next month because of seasonal delay of mail (December issue reached Sacramento Jan. 4). Sir V. Ayer's approximation was sent by Prof. Howard K. Preston. An excellent solution by Joseph M. Brandstetter is direct for the pool centers but indirect for the fence. There were many Joe Kerrs wiggling in on the fence line.

Claiming cousinship, Neare Lee Wright II (Allyn P. Bursley) found a rounded tetradecagonal prism holding 1,995 (19 × 105) cubes, outdoing Wadhouse's 1,932 (October problem), and solved the shadow-chase problem (November) by hyperbolic approximations.]

Seabees Need Engineers

RECENT news releases and publicity have highlighted the current urgent need for civil engineers in the Navy to serve with the famed Construction Battalions, or Seabees as they are popularly called. Much has been written concerning their exploits and accomplishments. The tradition which has grown up around the Seabees is legendary, although until the outbreak of the war no such organization existed at all.

Instead of 209 officers, both regular and reserve, which was the total of the entire officer complement of the Bureau of Yards and Docks at the end of World War I, there are now approximately 8,000 regular and reserve officers and more than 250,000 Seabees and construction specialists, fighting and building bases in all parts of the world.

Several hundred more civil engineers are needed, however, to fill new battalions now being formed. Civil engineers with field experience in building and heavy construction are urgently needed to take over the new bases being wrested from the enemy almost daily. With the current drop in domestic construction and the termination of many government building contracts, many engineers are being released from critical and essential war jobs. These men should make application to serve in one of these new battalions. If found physically qualified and if other qualifications meet the standard of the Navy, these men may also contribute to the legend and tradition of the fighting Seabees, whose motto is, "Can do!" Lt. Gen. Alexander Vandergrift, Commandant of the Marine Corps, quotes his field officers as saying, concerning the Seabees, "They build roads so fast that the Japs are using them as avenues of retreat."

Any Office of Naval Officer Procurement will gladly furnish additional information. These offices are located in the major cities of the United States.

A.S.T.M. Issues Bulletin on Soil Testing

THIS 210-page compilation—recently issued by the American Society for Testing Materials through the intensive work of its Committee D-18 on Soils for Engineering Purposes—gives, in addition to all the A.S.T.M. standard methods, some 38 suggested procedures for investigating soil and soil mixtures. The volume has been divided into five parts: Indicator Tests on Soils; Compaction and Consolidation Tests on Soils; Strength Tests on Soils; Tests for Soil Cement; and Tests for Soil-Bituminous Mixtures.

Copies of the publication in heavy paper binding are available upon application to the A.S.T.M. headquarters at 260 South Broad Street, Philadelphia 2, Pa., at a cost of $2.25. Reduced prices may be obtained on orders in quantity.

Change to Metric System Advocated

In a recent issue of "Science and Appliance," published by the Ohio State University Research Foundation, appeared a brief for adoption of the metric system for both scientific and general business operations. It was entitled "A Good Time for a Change." In view of certain simplifications that would eventually result in civil engineering computations and field work, excerpts are quoted here, merely as information.

For several million young Americans the kilometer has become a real measure of distance. These same citizens have also had experience with the liter and the kilogram. It has been suggested that upon their return we scrap our so-called English system of weights and measures and adopt the metric system.

We had that chance when the boys came back after the other war. In many respects 1919 would have been a better time for the change than 1945. In the past quarter century we have had an enormous expansion of the use of precise measurements in industry. We didn't do it then, but now we are more international minded. The cost would be great, but it might pay. The longer we put off the change the more expensive it will be.

One logical reason for considering the adoption of the metric system for general business is that we shall need to use a good deal of it anyhow, and we might as well go all the way and save duplication. The products we sell abroad will have to be made to metric measurements, and we could buy to greater advantage if we took items on the metric system. The change would be good business.

Of course, we still have dear old unmethodical England and the Empire countries to consider. But even there our measurements fail to jibe well. We find confusion about gallons, tons, and other items. The argument can be discounted.

Certainly there would be inconveniences. Nevertheless, the United States, with its standards of education and its present stage of world consciousness, should be able to take the readjustment in stride. It seems probable that the initial cost would be offset by the possibilities of great future gain.

Our habits of thinking in terms of the old measurements would persist, but even in that particular the readjustment would not be difficult. The late Professor A. E. Kennelly wrote a book about twenty years ago reporting how Europeans managed in using the metric units. He found that the pre-metric terms are common in conversation to designate the approximate equivalents in metric measurements. For example, a half kilogram is ordinarily called a pound. Thus traditional habits of thinking and speaking get along very well with the use of the international decimal system. And the arithmetic is certainly easier.

Where Honor Is Due

AT A RECENT meeting of the Mid-South Section of the Society, J. M. Page, M. Am. Soc. C.E., used an interesting quotation in introducing a speaker. This quotation, which follows, is by David C. Beaman, and appeared in the *Handbook of Water Control*, published by the California Corrugated Culvert Company, a member of the Armco Drainage Products Association:

"Although the tomb of Moses is unknown, the traveler of today slakes his thirst at the well of Jacob. The gorgeous palaces of the wisest and wealthiest of monarchs, with their cedar and gold and ivory, and even the great temple of Jerusalem, hallowed by the visible glory of the Deity Himself, are gone; but Solomon's reservoirs are as perfect as ever. Of the magnificent and costly architecture of the Holy City, not one stone is left upon another, but the pool of Bethesda commands the pilgrims' reverence at the present day. The columns of Persepolis are moldering into dust, but its cistern and aqueduct remain to challenge our admiration. The golden house of Nero is a mass of ruins, but the Aqua Claudia still pours into the city of Rome its limpid stream. The Temple of the Sun, at Tadmor in the wilderness, has fallen, but its fountain sparkles in the rays of the morning as when thousands of worshippers thronged its lofty colonnades.

"And if any work of this generation shall rise over the deep ocean of time, we may well believe that it will be neither palace nor temple, but some vast aqueduct or reservoir; and that if any name shall hereafter flash brightest through the mist of antiquity, it will probably be that of the man who in his day sought the happiness of his fellow man, and linked to his memory some such work of national utility or benevolence."

Holland Makes Preparations for Draining Flooded Lowlands

PLANS are under way for the reclamation of the vast areas in the Netherlands that have been flooded by the Germans. The Netherlands government has started to procure the necessary machinery and equipment by placing an order in this country for two hundred pumps having a combined capacity of 3,500,000 gal per min. These pumps will be used to drain the flooded lowlands in existing channels or canals. Diesel engines to supply driving power have also been ordered.

The pumps are of the low-head, centrifugal type, 20, 24, and 36-in. units. Each is capable of sending from 15,000 to 26,000 gal per min through a network of pipes to be shot over the dikes, just high enough to clear them. Diesel power was chosen, because the Netherlands people believe they will have a better chance of obtaining fuel oil than bulky coal.

Orders placed total twelve million dollars, which includes power plants, pipe materials, and such equipment as draglines, bulldozers, and tractors for the repair of dikes and locks. United States government agencies are cooperating by giving clearance on diesel engines, which stand high on priority lists.

Problems of Planned Subdivisions Analyzed in New Bulletin

WITH a huge postwar home-building boom in prospect, which will convert the present fringes of cities into new residential subdivisions, the National Committee on Housing has made public the results of an extensive study of methods of avoiding the evils and economic loss which have followed past building booms.

This study—entitled "Neighborhood Design and Control, and Analysis of the Problems of Planned Subdivisions"—not only surveys past experience but indicates the steps that should be taken now to avoid a repetition of wild-cat speculation in land and the sprouting of poorly planned and quickly deteriorating sections.

The bulletin is available upon application to the National Committee on Housing, Inc., 512 Fifth Avenue, New York 18, N.Y., at a cost of 60 cents to members, and $1 to non-members.

Newsletter of Value to Planners

A NEWSLETTER of value to planners and engineers interested in the various phases of planning, is being prepared by the American Institute of Planners. The publication will include timely items, pertinent to the fields of physical, economic, and social planning, and it is particularly directed toward the man in the service who has little time to keep abreast of current planning trends by reading lengthy works.

"Newsletter" will be distributed free to all men in the Armed Forces and to a limited number of others, upon application to Mr. Draveaux Bender, Executive Secretary of the American Institute of Planners, 77 Massachusetts Avenue, Cambridge 39, Mass.

NEWS OF ENGINEERS

Personal Items About Society Members

DUGALD C. JACKSON, professor emeritus of electrical engineering at Massachusetts Institute of Technology, was recently elected an honorary member of the American Institute of Electrical Engineers. Long prominent as a consultant in the field of electrical engineering, Dr. Jackson was on the staff of the Massachusetts Institute of Technology from 1907 until his retirement in 1935.

CROSBY MILLER has succeeded the late IRA L. PYLE as chief engineer of the Chesapeake and Ohio Railway Company, with headquarters in Richmond, Va. Mr. Miller was formerly assistant chief engineer.

NORMAN M. SMITH, rear admiral, Civil Engineering Corps, U.S. Navy, retired, is now president of the University of South Carolina.

HERBERT H. HOWELL, who is connected with the Civil Aeronautics Administration, has been transferred from Columbus, Ohio, where he was district engineer, to Kansas City, Mo.

JAMES B. RAMSEY has been appointed chief engineer and superintendent of the Kansas City (Mo.) Water Department. He was formerly chief engineering draftsman.

JOSEPH L. BURKHOLDER, formerly assistant general manager of the Metropolitan Water District of Southern California, was recently appointed manager-engineer of the San Diego County Water Authority.

GERALD T. MCCARTHY, a member of the New York consulting firm of Parsons, Brinckerhoff, Hogan and MacDonald, is now manager of the firm's work in Latin America, with headquarters at C. A. Calle Sur 17, No. 27, Caracas, Venezuela.

JOHN W. GREENLEAF, JR., has been promoted from the rank of captain in the Sanitary Corps of the U.S. Army, to that of major. At present he is with a field party in Paraguay.

OLIVER G. BOWEN and E. ALAN ROWE announce that, with RHODES E. RULE and Gerald Bowen, an aeronautical and mechanical engineer, they have reorganized their engineering practice under the name of Bowen, Rowe, Rule and Bowen. Their main office is at 2835 Gilroy Street, Los Angeles 26, Calif.

W. C. WHITMAN has severed his connection as field engineer for the Texas State Highway Department at Dallas in order to join the engineering department of the Magnolia Petroleum Company, with headquarters in the same city.

WILLIAM G. SAVILLE is now with the firm of Crocker and Ryan, consulting engineers of Denver, Colo. Mr. Saville was formerly structural engineer for the TVA at Knoxville, Tenn., and more recently in the U.S. Engineer Office at Seattle, Wash.

ROBERT O. DAVIS was recently promoted from the rank of captain in the Air Corps, U.S. Army, to that of major. He is in charge of the St. Louis (Mo.) office of the Aeronautical Chart Section of the Army Air Forces.

SAMUEL W. MEDLER, of Knoxville, Tenn., is connected with the Badger Ordnance Works at Baraboo, Wis.

JAMES B. WARD, lieutenant (jg), U.S. Naval Reserve, is now stationed in the Southwest Pacific with the Seabees.

E. P. MATHEWS, former associate editor of the *Tennessee Valley Engineer* and now with the Seabees, writes that he has seen action on Saipan and is at present in the Philippines. He has the rank of lieutenant (jg) in the U.S. Naval Reserve.

GANO DUNN, LOUIS MITCHELL, HARRY S. ROGERS, THORNDIKE SAVILLE, and LEWIS K. SILLCOX have been appointed by Governor Dewey to serve on an advisory committee to the New York State Department of Commerce. The committee is to advise on the technical and industrial development in the state. S. C. HOLLISTER'S membership on the committee was noted in the December issue.

ANDERS BULL announces that he is retiring from his position as civil engineer for the New York Board of Transportation after a number of years of service. His address will be 67—127 Clyde Street, Forest Hills, N.Y.

JOHN F. BONNER is now a lieutenant colonel in the Coast Artillery Corps of the U.S. Army, the rank representing a recent promotion from that of major. He is in the European theater of operations.

JOHN N. SPAULDING, lieutenant, U.S. Naval Reserve, has been assigned to duty at the Bureau of Yards and Docks in San Francisco. Until lately he was with the Seabees in the Southwest Pacific area.

GLENN B. WOODRUFF and RAPHAEL SAMPSON announce that they have established a structural engineering practice at 310 California Street, San Francisco. They were formerly with Utah—Pomeroy—Morrison at Provo, Utah.

DECEASED

EDWARD PERRY BABCOCK (M. '30), consulting engineer of Chicago, Ill., died on November 15, 1944, at the age of 85. From 1911 to 1917 and, again, from 1919 to 1923 Mr. Babcock was with the Chicago Bureau of Engineering. Beginning in the latter year, he was for ten years principal assistant engineer for I. F. Stern, Chicago consultant, on the construction of bridges and buildings and other structures. Mr. Babcock then established his own practice.

DEANE FRANCIS BIXBY (Jun. '42) first lieutenant, U. S. Army, died of wounds received in action in Germany on December 4, 1944. Mr. Bixby was 23 years old and a graduate of Oregon State College, from which he received the degree of B.S. in C.E. in 1942. His home was in Portland, Ore.

HARRY WILLIAM BOETZKES (M. '20), senior engineer for the U.S. Engineer Department, Sacramento, Calif., died in the Veterans' Hospital at Yountville, Calif., on November 29, 1944. At one time Mr. Boetzkes maintained a construction engineering practice in Seattle and later (1931 to 1937) was construction engineer for the W. A. Bechtel Company at Lokoya, Calif. He had been in the U.S. Engineer Department for the past five years, but was absent on sick leave at the time of his death.

RALPH MARKS BURKHALTER (Assoc. M. '23) chief engineer for the Poirier and McLane Corporation, of New York, N.Y., died at his home there on December 14, 1944. His age was 58. For some years Mr. Burkhalter was with the George A. Fuller Company, of New York, N.Y., and since 1935 he had been chief engineer for Poirier and McLane. One of the early specialists in the compressed air method of tunnel construction, he played a part in the construction of many of the major highway projects in the New York metropolitan area, including the Holland Tunnel and the Triborough Bridge. During the present war he had been in charge of work on a large munitions depot at Geneva, N.Y.

EMERSON DOLLIVER (Assoc. M. '29) associate hydraulic engineer for the California State Division of Water Resources, Sacramento, Calif., died suddenly at his home there on December 2, 1944. Mr. Dolliver, who was 47, served with the U.S. Army in France in 1918. Later he was for some years engineer for the Wallace and Tiernan Company—first in

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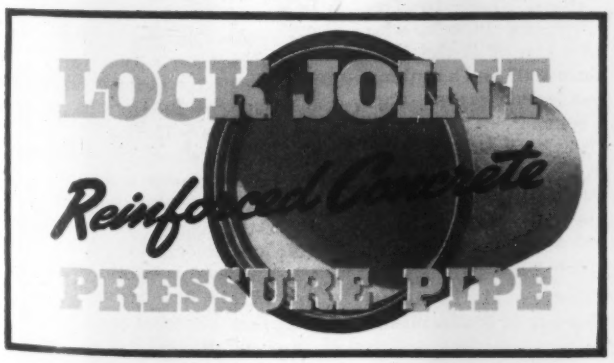

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attle, Wash., and then in San Francisco. Since 1939 he had been with the California State Division of Water Resources. Long active in the work of the Sacramento Section, Mr. Dolliver served as secretary in 1941.

JAMES PATRICK FARRELL (Assoc. M. '20) of Drexel Hill, Pa., died in a hospital in Lansdowne, Pa., on December 20, 1944, after a long illness. He was 55. From 1911 to 1917 Mr. Farrell was a contractor in Philadelphia; from 1917 to 1928, district superintendent for the Austin Company in Philadelphia; from 1928 to 1931, zone engineer for the Atlantic Refining Company; and from 1931 to 1942, sales manager and engineer for the Petroleum Heat and Power Company in Philadelphia. More recently he had been project manager for the Duffy Construction Corporation, of New York City, in charge of a war construction project.

GEORGE LINZY GOUINLOCK (Jun. '36) ensign, Civil Engineering Corps. U.S. Naval Reserve, was killed in action on June 6, 1944. Mr. Gouinlock was 30 years old and a graduate of Syracuse University, class of 1936. From 1937 until 1942 he was senior engineering draftsman for the Tennessee Valley Authority at Chattanooga, Tenn.

ELMO GOLIGHTLY HARRIS (M. '01) professor emeritus of civil engineering at the Missouri School of Mines, died at his home in Rolla, Mo., on December 21, 1944. Professor Harris, who was 83, had been on the staff of the Missouri School of Mines for fifty-three years—for forty years as professor and head of the department of civil engineering and for the past thirteen years as professor emeritus. He was the author of numerous engineering works.

HENRY WILD HAYES (M. '01) retired civil engineer, died at Hollis, N.H., on November 14, 1944, at the age of 77. Mr. Hayes spent his early career in railroad engineering, having been with the Fitchburg (Mass.) Railroad from 1887 to 1900 and the Boston and Maine Railroad from 1900 to 1908. He then (1908 to 1914) served as an engineer in the Grade Crossing Department of the Commonwealth of Massachusetts, and from 1914 until his retirement in 1927 was, successively, engineer for the Public Service Commission and chief engineer of the Department of Public Utilities, Commonwealth of Massachusetts.

WALTER HAROLD KIRKBRIDE (M. '15) until recently chief engineer of the Southern Pacific Company, San Francisco, Calif., was fatally stricken in Dunsmuire, Calif., on December 20, 1944, while on a business trip. He was 71 years old. A member, with ex-President Hoover, of the first class to be graduated from Stanford University, Mr. Kirkbride began his career as a government mining surveyor. Taking up railroad construction, he became connected with the Sierra Railway and the Shasta Mineral Belt Railway before joining the Southern Pacific in 1902. For the past twelve years he had been chief engineer of this railroad and of its subsidiary lines. In 1935 Mr. Kirkbride was the recipient of the Thomas Fitch Rowland Prize.

RALPH BRIGGS KYLE (M. '19) of Gainesville, Fla., died there on November 22, 1944, at the age of 64. Mr. Kyle had been cost engineer for Black and Laird, Ltd., of New Orleans, La., on the construction of a water-purification plant for the city; engineer for the South Jersey Realty Company; and engineer for La Compania Mexicana, of London, England, on the design and construction of harbor installations in Lower California. Later he was a member of the New Orleans firm of Kyle and White, and more recently had been secretary and general manager of the Retort Chemical Company at Mossy Head, La., retiring in 1936.

ALFRED EMANUEL LINDAU (Assoc. M. '06) principal civil engineer for the 14th Naval District, U.S. Navy, Honolulu, Hawaii, died on December 14, 1944. For some years Mr. Lindau was connected with the Metal and Corrugated Bar Company—as manager of the Western Division in Chicago, and later, as general manager of sales in Buffalo. From 1929 to 1932 he was president of the American System of Reinforcing, with offices in Chicago, and later president of the American Wire Fence Company. In 1940 Mr. Lindau went to Hawaii to make studies of concrete in connection with the Western Pacific air base work, and remained in Honolulu as principal civil engineer for the 14th Naval District.

ARTHUR KERSHAW OLSEN (M. '43) captain, Specialist Reserves, U.S. Army, died on November 17, 1944, while serving with the Allied Military Government in Germany. Mr. Olsen, who was 40, had degrees from the University of Utah and La Salle University in Chicago. From 1926 to 1929 he was with the Iowa Highway Commission; from 1929 to 1935, county highway engineer for Union County, Iowa; and from 1935 to 1941, general manager and superintendent of the Creston (Iowa) Water Works. From the latter year until he entered Army service he was assistant chief of operations in the Special Engineering Division of the Panama Canal.

HARRY ALFRED PARR (Jun. '41) first lieutenant, Corps of Engineers, U.S. Army, was killed in action in Germany on November 27, 1944. He was 27 years old and a graduate of the University of New Hampshire, class of 1941. For a year following his graduation, Lieutenant Parr was in the U.S. Engineer Department. In May 1942 he was commissioned a second lieutenant in the Corps of Engineers, U.S. Army. His home was in Hampton, N.H.

GEORGE WELLINGTON PICKELS (M. '24) professor of civil engineering at the University of Illinois, Urbana, Ill., died on December 2, 1944. Professor Pickels, who was 61, had been on the staff of the University of Illinois since 1907 and a ranking professor for the past twenty years. Earlier in his career he spent three years with the Chicago and Alton Railroad, and during the first World War served in the Air Service, with the rank of first lieutenant. Professor Pickels was the author of numerous works on railroad and route surveying, land drainage, and flood control.

JAMES CHARLES PINNEY (M. '18) assistant engineer, U.S. Bureau of Reclamation, Denver, Colo., died in that city on December 2, 1944, at the age of 62. From 1910 to 1912 Mr. Pinney was assistant professor of civil engineering at Marquette University, and from 1912 to 1917 lecturer on statically indeterminate stresses there. For part of this period he was also, superintendent of bridges and public buildings for the city of Milwaukee. From 1917 to 1924 Mr. Pinney was dean of the college of engineering at Marquette University; from 1924 to 1934 in consulting practice at Fort Myers, Fla.; and from 1934 to 1938, chief of party for the U.S. Coast and Geodetic Survey. Since 1938 he had been with the U.S. Bureau of Reclamation.

CORYDON TYLER PURDY (M. '93) chairman of the board and former president of the Purdy and Henderson Company, of New York, N.Y., died at his home in Melbourne, Fla., on December 25, 1944. His age was 85. Mr. Purdy opened his first office as a consulting engineer in Chicago in 1889, and formed the partnership of Purdy and Henderson in 1893, establishing the New York office a year later. One of the early developers of the steel skyscraper, Mr. Purdy was in charge of the structural design of many important New York buildings, including the Metropolitan Life Tower and the Whitehall Building. In 1900, at the request of the U.S. Government, he prepared an exhibit for the Paris World's Fair, showing the details and methods of modern steel-frame construction. Mr. Purdy retired about five years ago.

IRA LAWRENCE PYLE (M. '40) chief engineer for the Chesapeake and Ohio Railway, Richmond, Va., died on May 1, 1944. Mr. Pyle, who was 67, had spent his entire career with the Chesapeake and Ohio, having gone there in 1902 in the capacity of levelman. He was promoted through the various grades, becoming assistant chief engineer in 1923 and chief engineer in 1939. In the latter capacity he was in charge of the supervision of all engineering design and construction.

HERBERT LAWRENCE RIPLEY (M. '0[illegible] retired civil engineer, died at his home in New York City on December 1, 1944, at the age of 70. Mr. Ripley spent most of his career with the New York, New Haven and Hartford Railroad, having gone there in 1898. In 1912 he resigned to serve for a year as engineer superintendent for Hollbrook, Cabot and Rollins on heavy construction, returning to the railroad company in 1913 in the capacity of chief engineer. Later he was engineering assistant to the vice-president and contract agent, retiring from active work in 1935.

LESTER CHAUNCEY SMITH (Assoc. M. '23) a partner in the firm of Doullut and Ewin, of New Orleans, La., died on November 17, 1944. Mr. Smith was for many years with the firm of Doullut and Ewin, with whom he was associated in the design and construction of various river and harbor improvements. Just prior to his death, he had acted as resident engineer on the construction of a large shipyard project at Mobile, Ala. During the first World War Mr. Smith served in the Engineer Corps of the Rainbow Division.

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WILLIAM DOWLIN TYLER (M. '09) retired engineer of Philadelphia, Pa., died on November 7, 1944. His age was 78. Beginning in 1907, Mr. Tyler was for many years connected with the Clinchfield Coal Corporation at Dante, Va.—first as chief engineer and, later, as vice-president. He retired in 1941. His earlier experience was with the Flat-Top Coal Land Association, for which he had been principal assistant in charge of all surveys. At one time Mr. Tyler was president of the Virginia State Board for Examination and Certification of Professional Engineers and Architects.

FRED FALCONER WELD (M. '22) structural engineer for the Puget Sound Navy Yard, Bremerton, Wash., died on October 23, 1944, at the age of 72. At the outset of his career Mr. Weld was with the U.S. Coast and Geodetic Survey, and later was with the Illinois Steel Company, of Chicago, and the Trussed Concrete Steel Company, of Detroit. From 1908 until recently he was in private practice as a civil engineer—chiefly in Seattle, Wash. Coincidentally, for part of this period, he taught mechanics and higher mathematics at the University of Washington.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From December 9, 1944, to January 9, 1945, Inclusive

ADDITIONS TO MEMBERSHIP

ARMSTRONG, ALVA JAMES (Assoc. M. '44), Engr., U.S. Engr. Office, Federal Bldg. (Res., 600 West North Ave.), Pittsburgh, Pa.

ARTHAUD, RICHARD EDWARD (Jun. '44), Ordnance Engr., Naval Ordnance Laboratory, Bldg. 212, Navy Yard, Washington 25, D.C.

AYDIN, ABDURRAHMAN ULUG (Jun. '44), Research Asst., Princeton Univ., Princeton, N.J.

BAILEY, DINSMORE HUBLEY, JR. (Jun. '44), Asst. Ship Supt., U.S.N., Bldg. 11, Navy Yard, Philadelphia, Pa.

BAIRD, MAURICE MARVIN (Jun. '44), Civ. Engr., Bay Eng. Co., 230 California St. (Res., 15 Crescent Ave.), San Francisco, Calif.

BARNARD, HAWLEY NEIL (M. '44), Engr., Cummins & Barnard, Inc., State Savings Bank Bldg. (Res., 1306 Ociuia Ave.), Ann Arbor, Mich.

BEK, ALVIN KENNETH (Jun. '44), Ensign, CEC, U.S.N.R.; 2008 Jackson Pl., Ann Arbor, Mich.

BLAKE, HAROLD WARREN (Jun. '44), Senior San. Eng. Aid, Div. of San. Eng., Dept. of Public Health, Room 511-A State House, Boston (Res. 55 Warren Ave., Marlboro), Mass.

BINFORD, THOMAS ANTHONY WALTER (Jun. '44), 945 Fifth Ave., Los Angeles 6, Calif.

BROWN, CARL BARRIER (Assoc. M. '44), Head, Sedimentation Section, SCS, Washington, D.C. (Res., 317 Pinewood Ave., Silver Spring, Md.)

BROWN, CARROLL STEWART (Jun. '44), Private, U.S. Army; R.D. 1, Mohawk, N.Y.

BROWN, LOUIS DEWITT (M. '44), Asst. Chf. Engr., Fraser-Brace Eng. Co., Inc., Naval Ordnance Plant (Res., 509 North Agee St.), Camden, Ark.

COLDWELL, ALBERT EDWARD (Assoc. M. '44), Associate Engr. (Hydr.), Corps of Engrs., War Dept., Box 61, Wright Bldg. (Res., 1331 South College Ave.), Tulsa 4, Okla.

CRANE, CHARLES HERMAN (Jun. '44), Staff Sgt., U.S. Army, Army Post Office 689, Care, Postmaster, New York, N.Y.

CHIN, QUONG POO (Jun. '44), Asst. Naval Archt., Naval Drydocks, Hunters Point (Res., 108 Waverly Pl.), San Francisco 8, Calif.

COOK, WESSON (Assoc. M. '44), Chf., Survey Div., Maryland-National Capital Park & Planning Comm., 8500 Colesville Rd., Silver Spring, Md. (Res., 6109 Twenty-sixth St., North, Arlington, Va.)

CORDINGLY, BRUCE TEMPLE (Jun. '44), Ensign, U.S.N.; 506 North Camden Drive, Beverly Hills, Calif.

DALE, EVERETT ELDRIDGE, JR. (Jun. '44), Private First Class, U.S.M.C.; 4806 Swiss, Dallas, Tex.

DAVIS, RICHARD LANE (Jun. '44), Private, U.S. Army; 253 South 2d East, Rexburg, Idaho.

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DELAMATER, RAY SPENCER (Assoc. M. '44), Lt. (jg), U.S.N.R.; 555 South Hillside, Wichita 9, Kans.

DIBERTO, EDWARD THOMAS (Jun. '44), Ensign, CEC, U.S.N.; 132 Sharon St., West Medford, Mass.

DOUGLASS, PAUL VARNEY (Assoc. M. '44), Associate Structural Engr., Veterans Administration, 1435 N St., N.W. (Res., 447 Nineteenth St., N.E.), Washington 2, D.C.

DULKEN, WALTER (Jun. '44), Junior Civ. Engr., E. W. Foley, Inc., 16 Court St., Brooklyn (Res., Hotel Greystone, Broadway and 91st St., New York), N.Y.

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FOX, CHARLES ROBERT (Jun. '44), Ensign, U.S.N., Naval Amphibious Training Base, Camp #4, Fort Pierce, Fla.

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FRIEDLEIN, FRANCIS DANIEL (Assoc. M. '44), Senior Engr., Rubber Bureau, War Production Board, Municipal Center Bldg. (Res., 4905 Bayard Blvd.), Washington 16, D.C.

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FULLERTON, THOMAS COXEY (Jun. '44), With Development Dept., Goodyear Tire & Rubber Co., Akron, Ohio. (Res., Kelsey Rd., Barrington, Ill.)

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